Record Hill Wind Project

Post-Construction Monitoring Report, 2012

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Executive Summary

In August 2009, Record Hill Wind LLC (Record Hill Wind) received permits to construct the 50.6-megawatt (MW) Record Hill Wind Project (Project) located in Oxford County, Maine. The Project received a Maine General Programmatic Permit issued by the U.S. Army Corps of Engineers (Corps; Permit # NAE-2008-03763) and a Maine Site Location of Development Act/Natural Resources Protection Act permit (Site Law/NRPA permit) issued by the Maine Department of Environmental Protection (MDEP; Permit # L-24441-24-A-N/L-24441-TF-B-N). Construction of the Project began in fall 2009 and the 22 Siemens SWT-2.3-93 wind turbines became operational in late 2011. As part of the permit conditions, a *Post-Construction Monitoring Plan* and *Eagle Risk Minimization Plan* each dated February 2012 were developed in consultation with and approved by the United States Fish and Wildlife Service (USFWS) and Maine Department of Inland Fisheries and Wildlife (MDIFW). In compliance with these plans, Stantec Consulting (Stantec) conducted a post-construction fatality monitoring survey, acoustic bat survey, and eagle and raptor migration surveys at the Project during Year 1 of operation in 2012. The Eagle Risk Minimization Plan had also included a summer eagle use survey if the eagle nest on French Island in Roxbury Pond was active in 2012. The nest was determined to be inactive during the spring 2012 surveys and therefore, MDIFW indicated via email on August 2, 2012 that the summer eagle surveys were not required.

Bird and bat mortality surveys

Bird and bat fatality searches were conducted weekly from April 15 to June 7 and July 7 to October 15. Turbine searches were conducted at all 22 turbines (100%) and the meteorological (met) tower. The turbines and the met tower were searched three times every two weeks, for an average search interval of approximately five days. The mortality study included searcher efficiency trials and carcass persistence trials (with game cameras).

During surveys, 724 (99.7%) of 726 scheduled turbine searches were completed, and 100% of 33 met tower searches were completed. Ninety-seven carcasses were found during the 2012 surveys: 44 bats and 53 birds. All bats were found during searches; 46 birds were found during searches and 7 were found incidentally.

All bat fatalities were tree-roosting bat species: hoary bat (*Lasiurus cinereus,* n=21, 48%), silver-haired bat (*Lasionycteris noctivagans*, n=13, 30%), and eastern red bat (*Lasiurus borealis,* n=10, 23%). All birds found were passerines with the most commonly found species represented by magnolia warbler (*Setophaga magnolia*, n=8, 15%), golden-crowned kinglet (*Regulus satrapa*, n=6, 11%), red-eyed vireo (*Vireo olivaceus*, n=5, 9%) and unidentified warbler (n=5, 9%). There were no federally or state endangered or threatened species found during the 2012 surveys. The bat species found, as well as American redstart (*Setophaga ruticilla*), black-and-white warbler (*Mniotilta varia*), chestnut-sided warbler (*Setophaga*

pensylvanica), Tennessee warbler (*Oreothlypis peregrina*), tree swallow (*Tachycineta bicolor*), and veery (*Catharus fuscescens*), are listed as Special Concern in Maine (MDIFW 2009).

Estimates of bat and bird mortality were calculated using the Huso Estimator (2012). Estimates of bat and bird mortality were 6.60 (bats) and 7.41 (birds) per turbine per year without area corrections, and 6.78 (bats) and 8.46 (birds) per turbine per year with area corrections. Estimates of bat and bird mortality were 2.89 (bats) and 3.24 (birds) per MW per year without areas corrections, and 2.96 (bats) and 3.70 (birds) per MW per year with area corrections.

Acoustic Bat Surveys

During the 2012 post-construction monitoring study, 4 acoustic detectors were deployed at turbines 1, 12, 17 and 22 in the Project area. Each of the 4 detectors was deployed at the edge of the turbine pad clearing, along the forest edge. The intent of the acoustic bat surveys was to document bat activity patterns and general species composition from the spring through the fall, and to document bat activity patterns in relation to the fatality survey data.

Detectors were deployed over the course of 3 days, from April 16 to April 18, and all 4 remained deployed until October 23, 2012. Combined, detectors recorded a total of 15,724 bat call sequences over a period of 639 detector-nights, resulting in an overall detection rate of 24.6 bat call sequences per detector-night. Individual detector rates ranged from 5.4 call sequences per night recorded at the Turbine 12 detector, to 49.5 call sequences per night at the Turbine 1 detector. The majority of calls were recorded at the Turbine 1 detector (52%, n=8,173 calls). The maximum activity recorded in a single night occurred on June 14 (805 total calls), when the average night time temperature reached 14 degrees Celsius (57 degrees Fahrenheit), and the average nightly wind speed was 4 meters per second.

Of those calls that could be identified to species or guild, calls from the big brown/silver-haired bat guild (BBSH) contained the highest number of call sequences (39%; n =6,190). Occasional equipment malfunctions and/or detector access issues occurred resulting in a 84% operation success among all four detectors, with valid data collected by detectors for 639 detector nights out of 759 calendar nights (for all detectors combined).

Eagle and Raptor Migration Surveys

Stantec conducted eagle and raptor migration surveys on 23 days in 2012, including 10 days in spring (between 3/20 and 5/18) and 13 days in fall (9/9 and 11/6) to document diurnal migration activity in the Project area. A total of 158.5 survey hours were conducted over the spring and

fall survey periods. Visual observation surveys were conducted generally from 9 am to 4 pm from Turbine 12[*,†].

Stantec documented 142 total raptor observations, 36 in spring and 106 in fall, representing 10 species. No federal or state-listed species were observed. In both seasons, turkey vulture (*Cathartes aura*) observations were most common (72%; n=26 in spring; 34%; n=36 in fall). Fall migration activity was over double that of spring; the overall passage rate in spring was 0.5 raptor observations per hour and in fall was 1.2 raptor observations per hour. Of raptors observed, 36% (n=13) in spring and 61% (n=65) in fall were observed in turbine areas. In spring, 77% (n=10) of raptor observations in the turbine area were documented at heights less than 126.5 m (the maximum height of the turbines) for at least a portion of their flight. In fall, 66% (n=43) of raptor observations in the turbine area were documented at heights less than 126.5 m.

Observers recorded 5 bald eagle (*Haliaeetus leucocephalus*) observations during spring and fall surveys. In spring, two adult eagles were observed outside the Project area over Roxbury Pond and Record Hill. One incidental eagle observation occurred on May 6 over Roxbury Pond. No eagle observations were made at the bald eagle nest on French Island during the spring surveys, and based on information provided by MDIFW, the nest was inactive in 2012. In fall, 3 eagle observations occurred near Turbines 12 (n=1) and 1 (n=2). In fall, 2 of the 3 observations crossed the turbine string above turbine height (as opposed to between turbines) near Turbine 12 and Turbine 1; the third observation occurred near Turbine 1 at heights between 150 m (492 ft) and 200 m (656 ft), but did not cross the ridge. One of the 2 observations that crossed the turbine string crossed at a high point along the ridge (A2) at approximately 600 m (1,969 ft) in height. The second observation crossed over A3 at heights between 200 and 250 m (820 ft).

Two turkey vulture observations and 1 merlin (*Falco columbarius)* observation exhibited turbine-avoidance behaviors including slight changes to their flight paths as they approached spinning turbines during the spring and fall surveys. No eagles or raptors collided with turbines at the Project in 2012.

[*] In spring, 7 one-hour surveys were sampled from the Project access gate ('Gate') where there was a clear view of Roxbury Pond. The purpose of the Gate surveys was to investigate if there was bald eagle activity at the historic nest site on French Island on Roxbury Pond.
[†] Three survey days in spring were conducted from Turbine 11 due to maintenance at Turbine 12.

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[‡] *This report was prepared by Stantec Consulting Services Inc. for the Record Hill Wind Project on behalf of Record Hill Wind LLC. The material in it reflects Stantec's judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. Stantec accepts no responsibility for damages, if any suffered by any third party as a result of decisions made or actions based on this report.*

1.0 Introduction

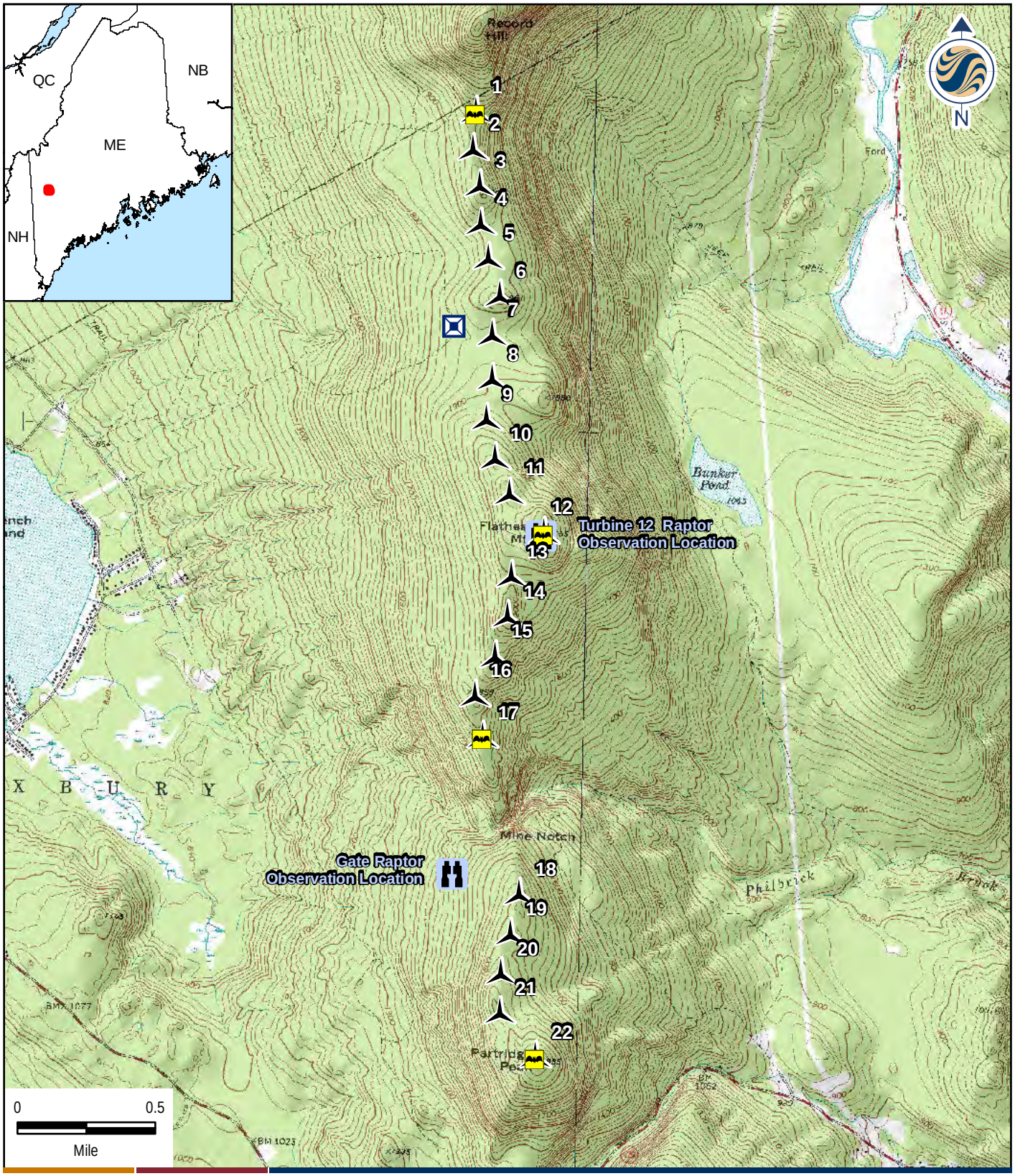
In August 2009, Record Hill Wind LLC (Record Hill Wind) received permits to construct the 50.6-megawatt (MW) Record Hill Wind Project (Project) located in Oxford County, Maine (Figure 1-1). The Project received a Maine General Programmatic Permit issued by the U.S. Army Corps of Engineers (Corps; Permit # NAE-2008-03763) and a Maine Site Location of Development Act/Natural Resources Protection Act permit (Site Law/NRPA permit) issued by the Maine Department of Environmental Protection (MDEP; Permit # L-24441-24-A-N/L-24441-TF-B-N). Construction of the Project began in fall 2009 and the 22 Siemens SWT-2.3-93 wind turbines became operational in late 2011. On behalf of Record Hill Wind, Stantec provided a draft post-construction monitoring plan to the MDEP, Corps, Maine Department of Inland Fisheries and Wildlife (MDIFW), and the U.S. Fish and Wildlife Service (USFWS) on November 3, 2011. Stantec subsequently met with representatives from the Corps, MDIFW and USFWS on December 22, 2011 to discuss the protocols detailed in the draft post-construction monitoring plan. The protocols described herein incorporate recommendations made by agency representatives at the December 22, 2011 meeting, as well as follow up recommendations from MDIFW in an email dated February 3, 2012. These protocols and are in compliance with the *Post-Construction Monitoring Plan* and *Eagle Risk Minimization Plan* dated February 2012.

In 2012, Stantec Consulting (Stantec) conducted a post-construction fatality monitoring survey, acoustic bat survey, and eagle and raptor migration survey at the Project. The specific objectives of each aspect of 2012 post-construction monitoring, as described in the *Post-Construction Monitoring Plan* and *Eagle Risk Minimization Plan,* were to:

- document the Project-related fatality rates of birds and bats;
- document bat activity during peak use and peak collision-fatality periods; and to
- document eagle and raptor use of the turbine areas and surroundings.

Given that there is a historic bald eagle nest on French Island in Roxbury Pond, the *Post-Construction Monitoring Plan* and *Eagle Risk Minimization Plan* also included summer surveys to characterize eagle use of the Project area during July and August when eaglets fledge and begin to fly. However, as indicated by MDIFW, this nest was determined to be inactive in 2012 during spring eagle nest surveys; therefore, with concurrence from USFWS and MDIFW via email on August 2, 2012, summer use surveys in 2012 were not conducted.

The maximum rotor-swept height of the turbines is 126.5 meters (m; 415 feet [ft]), with a rotor diameter of 93 m and a hub height of 80 m. The turbines are generally positioned north-to-south along the ridgeline consisting of Record Hill, Flathead Mountain, and Partridge Peak (Figure 1-1). Turbine lay-down areas created during construction have an approximate diameter of 96 m (317 ft). Cleared areas and steep side slopes are covered with larger sized blast rock, while the turbine roads and the base of the towers consist of gravel and crushed stone. There is one permanent met tower west of Turbine 7.



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Legend

- Turbine Search Plot
- Permanent MET Tower
- Bat Detector Location
- Raptor Observation Location

Client/Project
Record Hill Wind Project
Roxbury, Maine

Figure No.
1-1

Title
Survey Location Map
1/31/2013

2.0 BIRD AND BAT MORTALITY SEARCHES

2.1 MORTALITY SURVEY OBJECTIVES

The primary objective of mortality monitoring was to document injuries and fatalities of birds and bats as a result of collision with turbines and the permanent met tower at the Project. Specifically, the objectives of the mortality survey were:

- To calculate and estimate the mortality of birds and bats based on the results of standardized turbine searches, carcass persistence trials, and searcher efficiency trials;
- To compare the number of carcasses found at a Project with relatively large survey areas to other projects in the region with smaller search plots;
- To document scavenger activity and species with the use of game cameras; and
- To determine the level of bat activity (through acoustic detector surveys) relative to mortality and weather and turbine operations variables.

2.2 DATA COLLECTION METHODS

2.2.1 Fatality Search Methods

Bird and bat fatality searches were conducted weekly at Record Hill from April 15 to June 7 and July 7 to October 15. This timeframe covered the following wildlife activity periods:

- April 15 – June 7 (8 weeks): spring migration and early bird nesting and bat pup-rearing;
- July 7 – October 15 (14 weeks): summer bird nesting and bat pup-rearing, late-summer bat activity, and fall bird and bat migration.

Turbine searches were conducted at all 22 turbines (100%) and the met tower located west of Turbine 7 (Figure 1-1). Turbines were searched three times every two weeks, for an average search interval of approximately five days. The cleared area under the met tower guywires were also searched three times every two weeks. If a scheduled search could not be conducted due to turbine maintenance, it was visited later that day or the next day.

The Siemens SWT-2.3-93 2.3 MW turbines have a maximum rotor-swept height of 126.5 m (415 ft). Carcasses are known to fall substantial distances from the base of turbines (Hull and Muir 2010). A square search plot based on the full tower height would measure approximately 126.5 by 126.5 m (415 ft) centered on the tower, and would amount to an area of approximately 4 acres. A plot of this size would require a radius of 63.25 m (189.8 ft) around the base of the tower; however, this area is larger than the laydown area that was be cleared and leveled for

each turbine (typical radius of 48 m or 158.4 ft). Therefore, search effort was focused on the areas cleared and leveled for turbine laydown because searching beyond this area would have included heavily vegetated areas (i.e., mature and mixed age forest cover) and/or steep terrain. To account for carcasses that may have fallen outside of searchable areas (out to a radius of 63.25 m around each turbine), a correction factor was applied to estimates of bird and bat mortality. Area corrections were specific to each individual search turbine. The methods used for search area corrections are designed to account for any carcasses that may have fallen within truncated portions of a plot out to a distance equivalent to the maximum search distance on any side of that turbine. These methods cannot account for carcasses that may have fallen beyond the maximum search distance at each tower.

Transects spaced 4 m (13 ft) in width were established north-to-south within search plots and were oriented to be perpendicular to the dominant wind direction (west-to-east). Transects were marked with spray paint on rocks for easy navigation and consistency of area searched among searches.

Ground cover within searchable areas of survey plots was categorized into different visibility classes, according to the criteria outlined it Table 2-1.

Table 2-1. Ground cover visibility class descriptions (based on PGC 2007, as described in Arnett et al. 2010)

Visibility Class	% Vegetative Cover	Vegetation Height
1 (Easy)	greater than 90% bare ground	less than 6 inches
2 (Moderate)	greater than 25% bare ground	less than 6 inches
3 (Difficult)	less than 25% bare ground	greater than 12 inches

A Stantec biologist conducted approximately 33 turbine searches and 1 or 2 met tower searches per week, typically over a period of 4 to 5 days. During searches, the surveyor walked slowly, searching on both sides of transects for bird or bat fatalities. Any fatality found along or between transects was documented. All intact bird or bat carcasses or remnants of scavenged carcasses (a cluster of feathers representing more than a molt, or a patch of skin and bone) were documented as fatalities.

For each fatality found, multiple distinguishing photographs were taken, and the following information was recorded on standardized datasheets:

- turbine number;
- carcass distance from turbine (determined with a laser range finder);
- carcass direction from turbine (compass reading);
- carcass distance and direction from observer when found;
- date;
- surveyor;

- time discovered;
- ground conditions (vegetation type and height, wet, dry, etc.);
- species identification (including age and sex when possible);
- carcass position;
- stage of decomposition of the carcass (previous night, 2 to 3 days, 4 to 7 days, 7 to14 days, greater than 2 weeks);
- evidence of scavenger activity; and
- additional notes as necessary.

Carcasses were collected and frozen at the Record Hill Operations and Maintenance building. On those nights prior to mortality searches, sky conditions, including cloud height, cloud type, and percent cloud cover, and any notable precipitation events were recorded from a location in proximity to Record Hill. Additional weather information (wind speed, wind direction, air temperature, and barometric pressure) were collected from turbine nacelles in the Project area.

Any fatalities found by maintenance personnel or by surveyors outside of official weekly searches were documented as incidental and were removed from the study area and frozen. These findings were reported as incidental and were not included in the estimates of total mortality for birds and bats; however, these findings were included in the spatial and temporal summary of bird and bat fatalities.

Throughout the study period, a biologist recorded nightly weather conditions (cloud cover, type, and height and sky conditions and precipitation events) on nights prior to scheduled searches from a location near the Project. Temperature (°Celsius [C]), barometric pressure (mbar) and wind speed (meters per second [m/s]) were collected from a 60-m met tower, adjacent to Turbine 7.

2.2.2 Searcher Efficiency Trials

The objective of searcher efficiency trials was to estimate the percent of bird and bat carcasses that may go undetected during searches. Searcher efficiency trials, the timing of which was unannounced to the surveyor, were conducted throughout the study period. The study targeted the use of 10 trial carcasses of native species per trial. There were 3 separate trials conducted throughout the study period: (1) May 22, (2) August 14, and (3) September 24.

The trial coordinator left out carcasses early in the morning at turbines scheduled to be searched that day. Carcasses were placed in search plots at random distances and azimuths from turbines. Bird and bat carcasses, at varying stages of decomposition, were placed during trials. There were no bird carcasses larger than ruffed grouse placed during trials so as not to attract scavenging raptors to the site. Trial carcasses recovered by the surveyor were documented and collected by the surveyor. After the test, the trial coordinator picked up any carcasses not found by the surveyor and determined the number of carcasses recovered during the trial or as applicable, if carcasses had been scavenged.

2.2.3 Carcass Persistence Trials

Carcass persistence trials were conducted to determine the percent of carcasses that remain visible (i.e., not removed by scavengers or weather) between search intervals. The study targeted the placement of 10 carcasses, in good disposition (fresh disposition but previously frozen), of native species over the course of the study year. Carcasses were dispersed among different turbines to avoid carcass 'swamping' at any one location. There were no bird carcasses larger than ruffed grouse placed during trials so as not to attract scavenging raptors to the site. Four separate trials were initiated over the study period: (1) May 29, (2) July 30, (3) September 7, and (4) September 28. During trials, carcasses were placed at random distances and azimuths from tower bases.

The status of the carcasses was monitored over a period of 28 days (checked when nearby turbines were being searched). All evidence of insect, mammalian, or avian scavenging was noted on standardized datasheets. A carcass was considered present if it was partially scavenged but still readily detectable to a surveyor. A carcass was considered absent if it was completely removed or few feathers or other remains were left so that it was not readily detectable. Remaining carcasses were removed from search plots by the observer on day 28.

Moultrie Game Spy 65 and Bushnell Trophy Cam HD game cameras were set up near trial carcasses in an effort to capture video of scavengers. The Moultrie cameras have a detection range and a flash range of 14 m (45 ft) and a recovery time of 60 seconds; the Bushnell cameras have a detection range of 15 m (50 ft) and a recovery time of 2.9 seconds.

Individual cameras were deployed near a carcass for the duration of trial periods. Cameras were set to record a photo and then 30 seconds of video when motion activated. Photos and video were downloaded from the cameras throughout the trial periods and were reviewed for footage of scavengers.

2.2.4 Statistical Analysis

The following data summaries and statistical analyses were completed.

Timing of Fatalities

- Seasonal timing of fatalities (including those carcasses found during searches and incidentally); and
- Nighttime weather conditions when fatality events were suspected to have occurred (including those carcasses found in excellent disposition during searches and incidentally).

Spatial Distribution of Fatalities

- The range of distances that birds and bats were found from the towers, and the average distances birds and bats were found from towers (including those carcasses found during searches and incidentally);
- The distances and azimuths of carcasses from turbine bases were plotted on a scatterplot diagram with 10 m distance increments; and
- A statistical analysis of the spatial distribution of fatalities found during standard searches only was conducted, including:

1. the evenness of distribution of fatalities at individual turbines;
2. the location of fatalities at turbines in different topographical settings (crest, mid-slope, or saddle);
3. the location of fatalities at mid-string verses end-string turbines; and
4. the location of fatalities at FAA lit and FAA unlit turbines.

Chi-square tests for goodness-of-fit were used to determine if bird, bat, and all fatalities combined were evenly distributed among individual turbines. Count data (i.e., number of birds or bats found at turbines) are inherently non-normal distributed data; therefore, these data were modeled as Poisson distribution, a probability distribution that occurs when counting the number of occurrences of a rare event in a long series of trials. Non-parametric (i.e., distribution free) Kruskal-Wallis and Wilcoxon Rank Sum statistical tests, using SAS 9.1 (SAS Institute, Inc., Cary, NC), were conducted to compare the locations of fatalities at turbines in different topographical settings and at turbines with different project design characteristics. A probability value for the significance level of 0.05 was chosen prior to analyses.

2.2.5 Bird and Bat Mortality Estimates

Estimates of mortality were calculated using the Huso Estimator (Huso 2012), a method that was developed in 2010 based on Thompson (1992). Only carcasses found during standardized turbine searches were included in estimates of mortality (i.e., estimates did not include any fatalities found incidentally). One of the objectives of using the Huso Estimator was to attempt to accurately estimate bird and bat mortality based on observer detection rates and carcass persistence, and to provide a measure of precision associated with the estimates. The estimator was designed to estimate per-turbine and total-site fatality; it was not designed to estimate fatality at individual turbines.

A detailed description of the Huso Estimator is available in Huso 2010 and Huso 2012. The estimator software, available at http://pubs.usgs.gov/ds/729/, was run with the statistical program R (an open source statistical software package available at http://cran.r-project.org/). Annual estimates of mortality were calculated for birds and bats separately.

The total number of carcasses observed (C) is expressed as the product of the actual number killed (F), the proportion of carcasses that persist unscavenged (r), the proportion of carcasses that an observer actually sees (p), so that C = Frp; r is dependent on the length of time between a collision event and the time of the search; p is dependent on many potential covariates such as carcass size and ground cover. Total fatality (F) that has occurred over a period of time (T), at a wind project with (N) turbines, is estimated based on the number of carcasses observed during searches at a random sample of turbines (n).

$$\hat{F} = \sum_{i=1}^{n} \frac{1}{\hat{\pi}_i} \sum_{j=1}^{S_i} \sum_{k=1}^{K_{ij}} \frac{c_{ijk}}{\hat{r}_{ijk}\hat{p}_{ijk}\hat{v}_{ijk}} \text{ where } \hat{r}_{ijk} = \frac{\hat{\bar{t}}_{ijk}\left(1-e^{-\min(\hat{\bar{t}}_{ijk}, I_{ijk})/\hat{\bar{t}}_{ijk}}\right)}{\min(\hat{\bar{t}}_{ijk}, I_{ijk})}, \hat{\bar{t}}_{ijk} = -\log(0.01) * \hat{\bar{t}}_{ijk}, \text{ and } \hat{v}_{ijk} = \min\left(1, \hat{\bar{I}}_{ijk} / I_{ijk}\right)$$

When the size of search plots are limited, it is likely only a fraction of carcasses occurring at a turbine (i) will occur within the searchable area (Huso 2010). Therefore, π_i is the product of the proportion of fatalities at turbine i that is within the searchable area of a plot and probability of including (i) in the sample. An estimate of bird and bat mortality was calculated first without a search area correction factor (the model assumed the entire plot was searched [numerical value = 1]), then the model was run a second time using a carcass density-weighted proportion area searched correction factor (numerical value between 0 and 1).

The correction factor was applied to the actual number of carcasses found within 10-m distance annuli at individual turbines to account for the areas that were not searchable within a 126.5 by 126.5 m (16,002 square meter [m^2]) area. Methods to estimate the number of carcasses that may have occurred outside of searchable areas were based on those proposed by Jain et al. 2009 as modified from Fiedler et al. 2007. The boundaries of search areas at each turbine were mapped and the size of the searchable area was calculated. The number of bird and bat fatalities found within each 10 m annuli at each turbine was divided by the percent area searched within each annulus in order to generate a turbine-specific corrected number of bird and bat fatalities. For example, if 50% of the 31-40 m annulus was searchable at a turbine, and 5 bats were found within this annulus, then there were 5/0.5 = 10 adjusted fatalities for that annulus. The adjustments per annulus per turbine were totaled to derive a corrected number of carcasses per search turbine. Then, the number of actual carcasses found was divided by the number of corrected carcasses at each turbine to calculate a carcass density-weighted proportion area searched value to input into the Huso model.

In order for the Huso Estimator to calculate estimates of mortality for birds and bats separately, a sample size of at least 10 bird and 10 bat carcasses for both the searcher efficiency and carcass persistence trials is required. Further, there must be a sample size of at least 10 bird or carcasses per covariate (i.e., season, carcass size, ground cover type) for other covariates to be incorporated into the model (i.e., to estimate mortality per season, per carcass size).

The results of searcher efficiency trials were input into the model as 1 (if trial carcass was found) and 0 (if trial carcass was not found). These values are distributed as binary random variables within the model, with 'Found' indicated by the highest numeric value. A generalized linear model of the binary response is fit to the data, with a modeled response of $\log_e$ (odds of observing a carcass = $\log_e$ (p/1-p)).

The results of carcass persistence trials were input into the model based on the following trial outcomes:

- Carcass gone at first check on 'Day 1' of trial, left censoring = 2;
- Carcass still present (visible) on last day of trial, right censoring = 0; and
- Carcass was removed between checks, interval censoring = 3.

Carcass persistence times are modeled with a log-linear parametric accelerated failure time model and are assumed to follow a probability distribution. When persistence time is not known or is censored, the model is appropriately modified.

Each time the model is run, one of the following distributions of carcass persistence must be input into the model: Exponential, Loglogistic, Lognormal, or Weibul. Huso recommends running trials of the dataset with each distribution to compare values of AIC (Akaike information criterion), the measure of the relative goodness of fit of the model, where *k* is the number of parameters in the statistical model, and *L* is the maximized value of the likelihood function for the estimated model.

$$AIC = 2k - 2\ln(L)$$

The preferred distribution for the model is the one with the minimum AIC value. For the Record Hill analysis, carcass persistence was modeled using an exponential distribution with no covariates.

Thompson (1992) provides a formula for the calculations of variance when the variables of the model (i.e., carcass detectability and persistence) are known. However, because detection bias, persistence bias, and proportion of carcasses within search areas are estimated, Huso proposes a bootstrapped estimate of variance. This analysis used 5,000 bootstrap resample iterations, as recommended by Huso 2012. The alpha value was defined as 0.05; therefore, all confidence intervals were calculated at 95%.

2.3 FATALITY SURVEY RESULTS

2.3.1 Search Effort and Search Plot Visibility

During the 2012 surveys, 724 (99.7%) of 726 scheduled turbine searches were completed, and 100% of 33 met tower searches were completed. Two turbine searches could not be completed due to prolonged maintenance activities (a search was missed at Turbine 15 the week of August 13, and a search was missed at turbine 3 the week of October 8).

Table 2-2 describes the ground cover and visibility classes as well as the size of the area searched at each search turbine. The Visibility Class within all search plots was 1 (Easy) as, 100% bare ground characterized the ground cover within most plots; as much as 4% of the edge of a few search plots became overgrown with grass over the course of the study year but because these areas were so small they were believed to have negligible impacts on the overall visibility within plots (Table 2-2). Appendix A Figures 1-4 show the search plot boundaries at each search turbine.

Table 2-2. Description of search turbines, Record Hill 2012

Turbine No.	Visibility Class*	Elevation	FAA lighting	Ground Cover Description	Searchable Area m^2
1	1	607	light	100% gravel	5,586
2	1	599	no	97% gravel, 3% grass at southern edge	8,785
3	1	604	no	100% gravel	7,324
4	1	579	no	100% gravel	3,810
5	1	578	light	100% gravel	9,326
6	1	593	no	100% gravel	9,997
7	1	570	no	96% gravel, 4% grass at western edge	6,985
8	1	576	no	98% gravel, 2% grass at eastern edge	8,092
9	1	594	light	100% gravel	7,016
10	1	623	no	100% gravel	8,296
11	1	632	no	100% gravel	6,262
12	1	653	light	100% gravel	6,909
13	1	605	no	100% gravel	10,328
14	1	613	light	100% gravel	6,711
15	1	581	no	100% gravel	5,486
16	1	559	no	100% gravel	6,859
17	1	535	light	100% gravel	7,008
18	1	551	no	100% gravel	6,984
19	1	550	no	97% gravel, 3% grass at western edge	7,917
20	1	560	no	100% gravel	6,428
21	1	577	light	100% gravel	7,248
22	1	600	light	100% gravel	10,869
MET	2	n/a	n/a	95% grass, 5% mud	n/a
Ground cover visibility class descriptions (based on PGC 2007, as described in Arnett et al. 2010).					
Class 1 = Easy (ground cover is greater than 90% bare ground, vegetation height is <6 inches).					
Class 2 = Moderate (ground cover is greater than 25% bare ground, vegetation height is <6 inches).					

2.3.2 Bird and Bat Fatalities

Ninety-seven carcasses were found during the 2012 surveys: 44 bats and 53 birds (Table 2-3). All bats were found during searches; 46 birds were found during searches and 7 were found incidentally.

All bat fatalities were tree-roosting bat species: hoary bat (*Lasiurus cinereus,* n=21, 48%), silver-haired bat (*Lasionycteris noctivagans*, n=13, 30%), and eastern red bat (*Lasiurus borealis,* n=10, 23%).

All birds found were passerines with the most commonly found species represented by magnolia warbler (*Setophaga magnolia*, n=8, 15%), golden-crowned kinglet (*Regulus satrapa*, n=6, 11%), red-eyed vireo (*Vireo olivaceus*, n=5, 9%) and unidentified warbler (n=5, 9%).

There were no federally or state-listed endangered or threatened species found during the 2012 surveys. All three species of bat, and American redstart (*Setophaga ruticilla*), black-and-white warbler (*Mniotilta varia*), chestnut-sided warbler (*Setophaga pensylvanica*), Tennessee warbler (*Oreothlypis peregrina*), tree swallow (*Tachycineta bicolor*), and veery (*Catharus fuscescens*) are listed as Special Concern in Maine (MDIFW 2009).

Table 2-3. Bat and bird fatalities found during 2012 carcass searches, Record Hill 2012

Date	Search or incidental	Turbine No.	Common name	Age	Sex	Condition	Estimated Time Since Collision	Position	Distance	Direction (Azimuth)
BATS										
4/17/2012	search	11	silver-haired bat	adult	female	excellent/fresh	1-2 days	face down	31	57
4/22/2012	search	5	hoary bat	adult	female	fair/drying out	2-3 days	belly up	40	180
5/22/2012	search	1	hoary bat	unknown	unknown	poor/dry/rigid	2-3 days	belly up/scavenged	27	120
5/24/2012	search	20	hoary bat	adult	unknown	poor/dry/rigid	2-3 days	scavenged	25	90
5/29/2012	search	1	hoary bat	adult	unknown	fair/drying out	2-3 days	face down	5	260
5/31/2012	search	12	hoary bat	adult	unknown	fair/drying out	2-3 days	face down	0	0
7/12/2012	search	21	eastern red bat	adult	unknown	excellent/fresh	within 12 hrs	belly up	26	82
7/13/2012	search	11	eastern red bat	adult	unknown	fair/drying out	2-3 days	belly up	36	109
7/13/2012	search	12	eastern red bat	adult	unknown	fair/drying out	within 12 hrs	belly up	5	265
7/14/2012	search	15	eastern red bat	adult	unknown	fair/drying out	2-3 days	belly up	8	30
7/14/2012	search	16	eastern red bat	adult	unknown	fair/drying out	within 12 hrs	belly up	25	298
7/24/2012	search	1	hoary bat	adult	unknown	fair/drying out	2-3 days	belly up	35	91
7/24/2012	search	2	hoary bat	adult	unknown	fair/drying out	2-3 days	belly up	19	69
7/24/2012	search	21	silver-haired bat	adult	unknown	poor/dry/rigid	4-7 days	face down	7	42
7/25/2012	search	8	hoary bat	adult	unknown	excellent/fresh	within 12 hrs	belly up	41	172
7/25/2012	search	15	silver-haired bat	adult	male	poor/dry/rigid	1+ week	face down	0	342
7/26/2012	search	3	hoary bat	adult	unknown	poor/dry/rigid	1+ week	belly up	17	94
7/27/2012	search	11	hoary bat	adult	male	excellent/fresh	within 12 hrs	belly up	32	60
7/31/2012	search	8	silver-haired bat	unknown	unknown	fair/drying out	2-3 days	face down	7	282
7/31/2012	search	8	eastern red bat	unknown	unknown	fair/drying out	2-3 days	face down	35	195
8/1/2012	search	11	silver-haired bat	adult	male	fair/drying out	2-3 days	face down	4	59
8/1/2012	search	22	hoary bat	adult	unknown	poor/dry/rigid	2-3 days	face down	23	323
8/6/2012	search	2	eastern red bat	juvenile	female	poor/dry/rigid	2-3 days	belly up	1	339
8/6/2012	search	5	silver-haired bat	adult	unknown	poor/dry/rigid	2-3 days	face down	8	346
8/6/2012	search	1	eastern red bat	juvenile	unknown	poor/dry/rigid	2-3 days	belly up	0	275
8/6/2012	search	9	hoary bat	adult	unknown	fair/drying out	within 12 hrs	face down	26	63
8/7/2012	search	10	eastern red bat	adult	male	excellent/fresh	within 12 hrs	belly up	37	127
8/7/2012	search	14	hoary bat	juvenile	female	excellent/fresh	within 12 hrs	face down	0	270
8/8/2012	search	5	hoary bat	adult	male	excellent/fresh	within 12 hrs	face down	13	326
8/8/2012	search	5	hoary bat	adult	female	excellent/fresh	within 12 hrs	belly up	21	208
8/8/2012	search	7	hoary bat	adult	male	excellent/fresh	within 12 hrs	belly up	3	140
8/14/2012	search	1	hoary bat	adult	female	excellent/fresh	within 12 hrs	belly up	17	324
8/14/2012	search	2	eastern red bat	adult	male	excellent/fresh	within 12 hrs	balled up/mangled	42	218
8/14/2012	search	5	hoary bat	adult	male	excellent/fresh	within 12 hrs	face down	41	212
8/21/2012	search	6	hoary bat	adult	male	excellent/fresh	within 12 hrs	face down	15	140
8/21/2012	search	16	hoary bat	adult	female	excellent/fresh	within 12 hrs	belly up	8	n/a
9/2/2012	search	7	silver-haired bat	juvenile	male	excellent/fresh	within 12 hrs	belly up	35	329
9/2/2012	search	8	silver-haired bat	adult	male	excellent/fresh	within 12 hrs	face down	20	87
9/2/2012	search	13	silver-haired bat	unknown	male	excellent/fresh	within 12 hrs	belly up	12	330
9/2/2012	search	16	silver-haired bat	unknown	male	excellent/fresh	within 12 hrs	belly up	30	68
9/7/2012	search	1	silver-haired bat	unknown	unknown	fair/drying out	2-3 days	belly up	19	43
9/7/2012	search	14	silver-haired bat	adult	male	excellent/fresh	within 12 hrs	face down	0	15
9/8/2012	search	8	silver-haired bat	adult	female	poor/dry/rigid	2-3 days	face down	31	201
9/11/2012	search	13	hoary bat	adult	female	excellent/fresh	within 12 hrs	face down	26	99

(Table 2-3 cont.)

Date	Search or incidental	Turbine No.	Common name	Age	Sex	Condition	Estimated Time Since Collision	Position	Distance	Direction (Azimuth)
BIRDS										
4/16/2012	search	3	golden-crowned kinglet	adult	female	excellent/fresh	1-2 days	belly up	25	281
4/17/2012	search	10	golden-crowned kinglet	adult	female	fair/drying out	1-2 days	belly up	55	151
4/17/2012	search	11	golden-crowned kinglet	adult	male	fair/drying out	1-2 days	on-side	24	18
4/17/2012	search	11	golden-crowned kinglet	adult	female	fair/drying out	1-2 days	face down	26	121
5/7/2012	search	5	tree swallow	adult	unknown	excellent/fresh	within 12 hrs	belly up	10	180
5/10/2012	search	6	Swainson's thrush	adult	unknown	fair/drying out	1-2 days	on-side	15	140
5/12/2012	search	22	veery	adult	unknown	fair/drying out	1-2 days	scavenged	35	195
5/14/2012	search	1	scarlet tanager	adult	male	fair/drying out	2-3 days	scavenged	15	180
5/14/2012	search	2	blackburnian warbler	adult	female	fair/drying out	2-3 days	scavenged	31	271
5/14/2012	search	5	red-eyed vireo	adult	unknown	excellent/fresh	within 12 hrs	on-side	10	180
5/14/2012	search	5	magnolia warbler	adult	male	excellent/fresh	within 12 hrs	belly up	13	10
5/14/2012	search	5	ovenbird	adult	unknown	fair/drying out	2-3 days	belly up	18	0
5/14/2012	search	5	common yellowthroat	adult	female	excellent/fresh	within 12 hrs	belly up	33	33
5/15/2012	search	10	magnolia warbler	adult	male	excellent/fresh	1-2 days	belly up	23	238
5/15/2012	search	12	scarlet tanager	adult	unknown	excellent/fresh	within 12 hrs	wedged against rock	44	335
5/15/2012	search	14	American redstart	adult	male	excellent/fresh	within 12 hrs	wedged against rock	32	32
5/15/2012	search	17	veery	adult	unknown	excellent/fresh	within 12 hrs	belly up	15	60
5/15/2012	search	17	unidentified warbler	adult	unknown	fair/drying out	2-3 days	scavenged	21	112
5/16/2012	search	1	red-eyed vireo	adult	male	excellent/fresh	within 12 hrs	on-side	13	58
5/16/2012	search	3	magnolia warbler	adult	male	excellent/fresh	within 12 hrs	belly up	41	330
5/16/2012	search	21	hermit thrush	adult	unknown	fair/drying out	2-3 days	scavenged	26	52
5/17/2012	search	5	common yellowthroat	adult	male	fair/drying out	2-3 days	scavenged	11	160
5/17/2012	search	MET	northern parula	adult	male	fair/drying out	2-3 days	belly up	10	192
5/17/2012	search	MET	magnolia warbler	adult	male	excellent/fresh	within 12 hrs	belly up	5	268
5/17/2012	search	10	black-throated blue warbler	adult	female	fair/drying out	2-3 days	belly up	50	108
5/17/2012	search	11	unidentifed warbler	unknown	unknown	fair/drying out	2-3 days	scavenged	35	64
5/17/2012	search	11	unidentified warbler	adult	unknown	fair/drying out	2-3 days	scavenged	33	82
5/17/2012	search	11	unidentified passerine	unknown	unknown	fair/drying out	2-3 days	scavenged	40	89
5/17/2012	incidental	12	yellow-rumped warbler	sub-adult	unknown	excellent/fresh	1-3 days	on-side	20	10
5/17/2012	incidental	12	ovenbird	adult	male	excellent/fresh	1-3 days	face-down	23	350
5/17/2012	incidental	12	chestnut-sided warbler	adult	male	excellent/fresh	1-3 days	belly up	26	268
5/17/2012	incidental	12	black-and-white warbler	adult	female	excellent/fresh	1-3 days	belly up	26	268
5/18/2012	incidental	12	magnolia warbler	unknown	unknown	excellent/fresh	within 12 hrs	on-side	28	360
5/18/2012	incidental	12	chestnut-sided warbler	adult	male	excellent/fresh	within 12 hrs	wedged against rock	21	186
5/18/2012	incidental	12	magnolia warbler	unknown	unknown	excellent/fresh	within 12 hrs	on-side	23	335
5/21/2012	search	15	common yellowthroat	adult	male	poor/dry/rigid	2-3 days	belly up/scavenged	38	304
5/22/2012	search	1	red-eyed vireo	unknown	unknown	poor/dry/rigid	2-3 days	scavenged	20	279
5/22/2012	search	5	ovenbird	adult	unknown	fair/drying out	2-3 days	scavenged	31	172
5/23/2012	search	14	red-eyed vireo	unknown	unknown	fair/drying out	2-3 days	scavenged	28	52
5/29/2012	search	1	red-eyed vireo	adult	unknown	poor/dry/rigid	unknown	scavenged	17	338
5/30/2012	search	6	black-billed cuckoo	adult	unknown	poor/dry/rigid	unknown	scavenged	25	42
5/30/2012	search	5	unidentified warbler	adult	unknown	poor/dry/rigid	2-3 days	scavenged	17	92
5/30/2012	search	5	unidentified warbler	adult	unknown	fair/drying out	2-3 days	scavenged	32	335
5/31/2012	search	10	Magnolia warbler	adult	unknown	poor/dry/rigid	unknown	scavenged	28	89
5/31/2012	search	18	eastern wood-pewee	adult	unknown	fair/drying out	2-3 days	belly up	26	23
5/31/2012	search	1	red-eyed vireo	adult	unknown	fair/drying out	2-3 days	on-side	13	66
6/1/2012	search	9	unidentified passerine	unknown	unknown	poor/dry/rigid	2+ weeks	feather pile	30	102
8/13/2012	search	12	unidentified flycatcher	adult	unknown	excellent/fresh	2-3 days	belly up	18	30
9/2/2012	search	7	Tennessee warbler	adult	female	fair/drying out	2-3 days	belly up	23	30
9/2/2012	search	7	red-breasted nuthatch	adult	male	fair/drying out	2-3 days	face down	31	63
9/9/2012	search	2	magnolia warbler	adult	male	excellent/fresh	within 12 hrs	belly up	31	295
9/10/2012	search	10	golden-crowned kinglet	adult	male	fair/drying out	2-3 days	belly up	18	143
9/12/2012	search	8	golden-crowned kinglet	adult	male	fair/drying out	2-3 days	face down	21	178

2.3.3 Seasonal Timing of Fatalities

There were 6 bats (14%) found in the spring/early summer between April 17 and May 31; all other bats (86%; n=38) were found between July 12 and September 11 (surveys were not conducted between June 8 and July 6).

The majority of birds (n=47, 89%) were found during the spring/early-summer surveys. Six birds (11%) were found between August 13 and September 12. There were no carcasses found after September 12; surveys ended on October 15.

2.3.4 Fatality and Weather Comparisons

The date of collision was estimated to be the previous night for those birds and bats found in excellent condition (suspected to have collided within the past 12 hours). The date of collision was determined for 19 birds during 8 nights, and 23 bats during 14 nights. Table 2-4 provides the weather conditions for the nights when collisions were expected to have occurred.

Ten of the 22 nights with suspected fatalities were characterized by periods of rain or fog. For those nights when bat fatalities were expected to have occurred, the mean nightly wind speeds ranged from 2.38 m/s to 8.37 m/s, with an average mean nightly wind speed of 4.74 m/s. Mean nightly temperatures ranged from 8.53 C to 21.6 C, with an average mean nightly temperature of 16.67 C on those nights when bat fatalities were expected to have occurred. There were no observable trends between nights when bat fatalities were expected to have occurred and moon phase or sky conditions/precipitation events.

For those nights when bird fatalities were expected to have occurred, the mean nightly wind speeds ranged from 2.05 m/s to 9.37 m/s, with an average mean nightly wind speed of 4.92 m/s. Mean nightly temperatures ranged from 7.71 C to 13.84 C, with an average mean nightly temperature of 11.08 C on those nights when bird fatalities were expected to have occurred. There were no observable trends between nights when bird fatalities were expected to have occurred and moon phase or sky conditions/precipitation events.

Table 2-4. Date of suspected collision and weather conditions for birds and bats found in excellent condition, Record Hill 2012

Suspected Date Collision	# Bats or birds	% Cloud[1] cover	Cloud type/Height[1]	Mean Pressure (mBar)[2]	Mean wind speed (m/s)[2]	Mean temperature (C)[2]	Moon phase[3]	Sky conditions / Precipitation[1]
4/15/2012	1 bird	n/a	n/a	n/a	n/a	n/a	Waning Crescent, 19% of the Moon is Illuminated	partly cloudy
4/16/2012	1 bat	n/a	n/a	945.82	6.35	18.75	Waning Crescent, 12% of the Moon is Illuminated	clear to scattered clouds
5/6/2012	1 bird	0	n/a	952.59	2.26	9.03	Full, 100% of the Moon is Illuminated	calm, clear, freeze overnight
5/13/2012	3 birds	100	Sc/mid	954.21	2.05	12.01	Last Quarter, 42% of the Moon is Illuminated	unsettled weather, chance of rain
5/14/2012	4 birds	100	Sc - Cs/low	953.61	4.21	12.08	Waning Crescent, 33% of the Moon is Illuminated	rain predicted, am fog
5/15/2012	2 birds	100	Sc/low	948.93	3.02	11.77	Waning Crescent, 24% of the Moon is Illuminated	rain predicted
5/16/2012	4 birds	95	Sc - Cs/low	944.43	7.22	11.11	Waning Crescent, 16% of the Moon is Illuminated	ominous clouds and thunderstorms
5/17/2012	3 birds	n/a	n/a	954.03	6.30	7.71	Waning Crescent, 10% of the Moon is Illuminated	clear
7/11/2012	1 bat	n/a	n/a	955.83	3.47	18.39	Last Quarter, 44% of the Moon is Illuminated	clear to partly cloudy
7/12/2012	1 bat	n/a	n/a	954.97	3.41	20.56	Waning Crescent, 35% of the Moon is Illuminated	clear
7/13/2012	1 bat	n/a	n/a	954.59	3.75	21.69	Waning Crescent, 26% of the Moon is Illuminated	clear to partly cloudy
7/24/2012	1 bat	n/a	n/a	940.58	7.72	13.95	Waxing Crescent, 31% of the Moon is Illuminated	clear
7/26/2012	1 bat	n/a	n/a	939.80	2.38	15.24	First Quarter, 53% of the Moon is Illuminated	rain, fog, thunder, overcast
8/5/2012	1 bat	40	Cu - Sc/high	946.62	8.13	18.76	Waning Gibbous, 86% of the Moon is Illuminated	rain to overcast
8/6/2012	2 bats	80	Sc/mid	949.77	4.05	13.91	Waning Gibbous, 78% of the Moon is Illuminated	partly cloudy, mist, fog
8/7/2012	3 bats	10	Cu/high	949.13	3.84	17.76	Waning Gibbous, 70% of the Moon is Illuminated	clear to partly cloudy
8/13/2012	3 bats	60	Cu - Sc/high	948.25	3.89	17.80	Waning Crescent, 16% of the Moon is Illuminated	overcast, mist
8/20/2012	2 bats	15	Cu/high	947.18	3.89	15.90	Waxing Crescent, 11% of the Moon is Illuminated	partly cloudy to foggy
9/1/2012	4 bats	n/a	n/a	953.23	3.32	14.91	Full, 99% of the Moon is Illuminated	partly cloudy, mist, fog
9/6/2012	1 bat	70	Cu - Sc/high	945.98	3.84	17.29	Waning Gibbous, 67% of the Moon is Illuminated	partly cloudy
9/8/2012	1 bird	100	Ns - Cu/mid - low	939.26	9.37	13.84	Waning Gibbous, 49% of the Moon is Illuminated	rain, thunderstorms
9/10/2012	1 bat	n/a	n/a	950.00	8.37	8.53	Waning Crescent, 30% of the Moon is Illuminated	overcast to clear

Cloud classifications: Cirrus (Ci), Cirrocumulus (Cc), Cirrostratus (Cs), Altocumulus (Ac), Altostratus (As), Nimbostratus (Ns), Stratus (St), Cumulus (Cu)

1 Recorded by observer at a location near Record Hill.

2 Weather data downloaded from the met tower near Turbine 7.

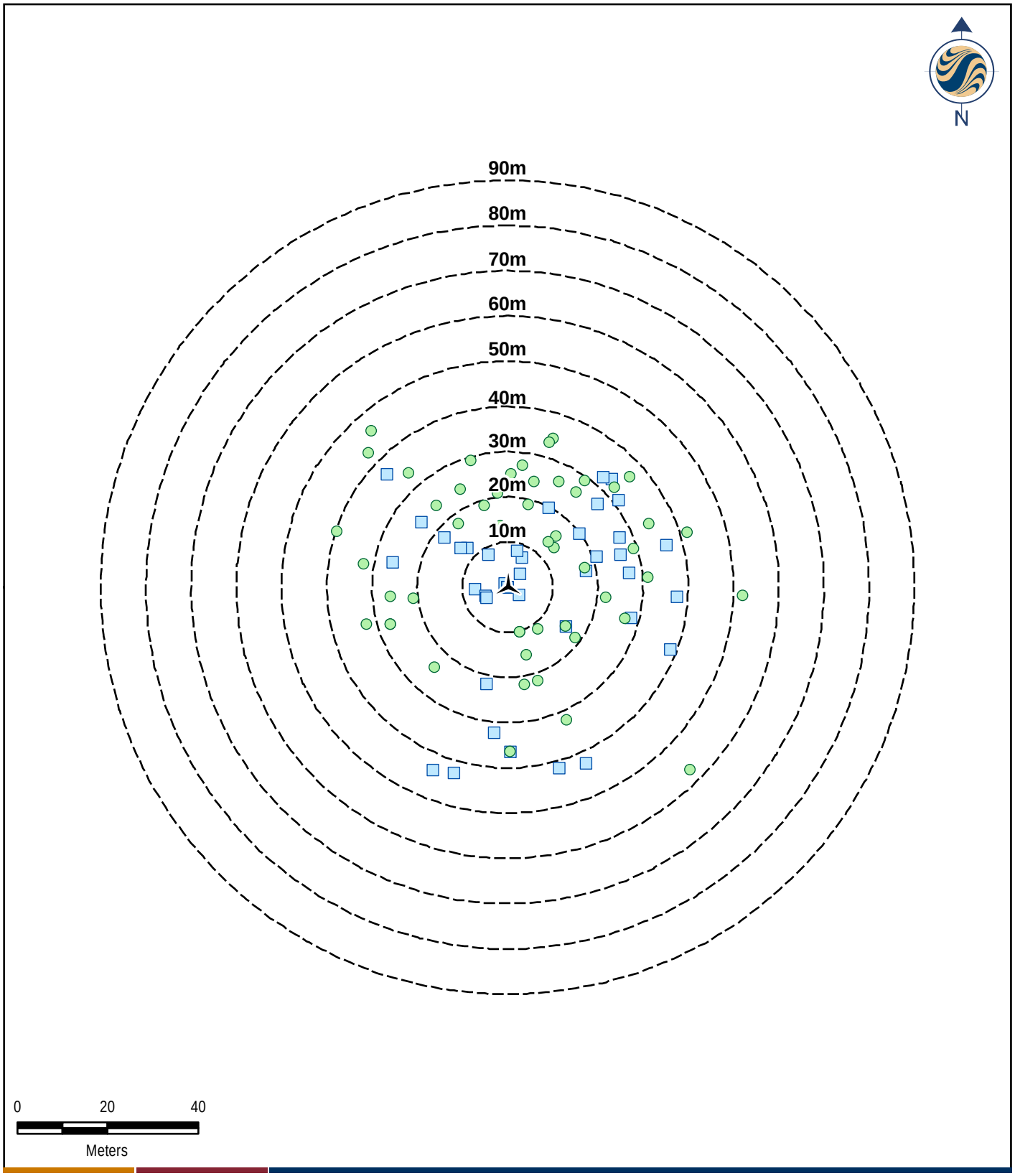
3 Archive moon phases downloaded from www.weatherunderground.com

2.3.5 Spatial Distribution of Fatalities

All bats were found at turbines, no bats were found at the met tower. The majority of birds were found at turbines (96%; n=51) with the exception of 2 birds found at the met tower.

The number of bats found at individual turbines ranged from 0 bats (at turbines 4, 17, 18, and 19) to 6 bats (Turbine 1). The number of birds found at individual turbines ranged from 0 birds (4, 13, 16, 19, and 20) to 9 birds (Turbines 5 and 12).

Figure 2-1 shows the locations of bird and bat carcasses found in 2012 at Record Hill within search plots at 10-m distance increments from tower bases. There were no observable trends in the distributions of bird or bat carcasses within all search plots combined.



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Legend

- Sample Turbine
- Bird Fatality
- Bat Fatality
- 10 Meter Buffer

Client/Project
Record Hill Wind Project
Roxbury, Maine

Figure No.
2-1

Title
Summary of Carcass Distances and Directions from Study Turbines

1/28/2013

Carcass distances from towers

The distances bats were found from turbine bases ranged from 0 m to 42 m; the average distance bats were found from turbine bases was 19.65 m. The distances that bird carcasses were found from turbine bases ranged from 10 m to 55 m; the average distance bird carcasses were found from turbine bases was 25.65 m. Figure 2-2 and 2-3 show the distribution of bat and bird carcasses found within 10 m distance increments from turbine bases.

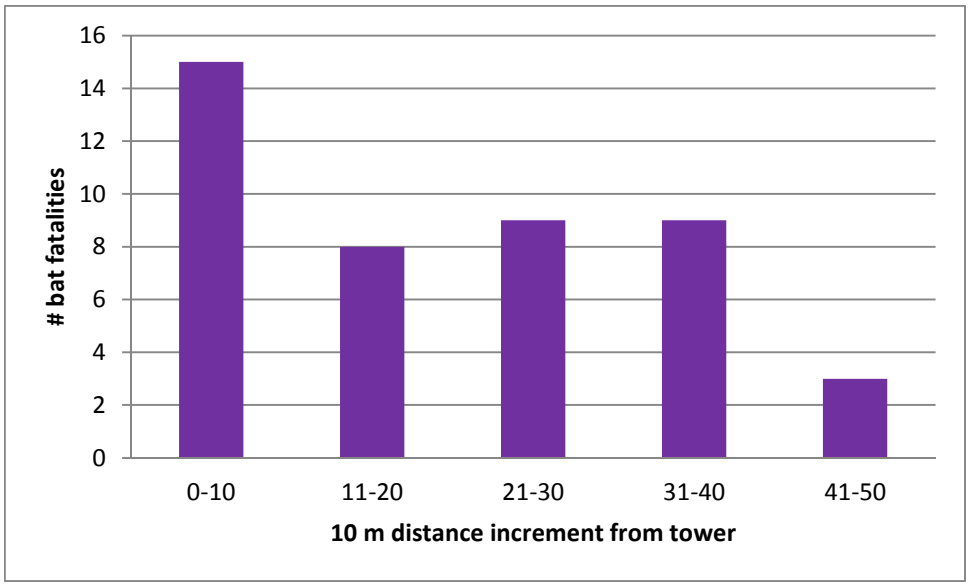

Figure 2-2. Distribution of bat carcasses found in 10 m distance increments from the towers, Record Hill 2012

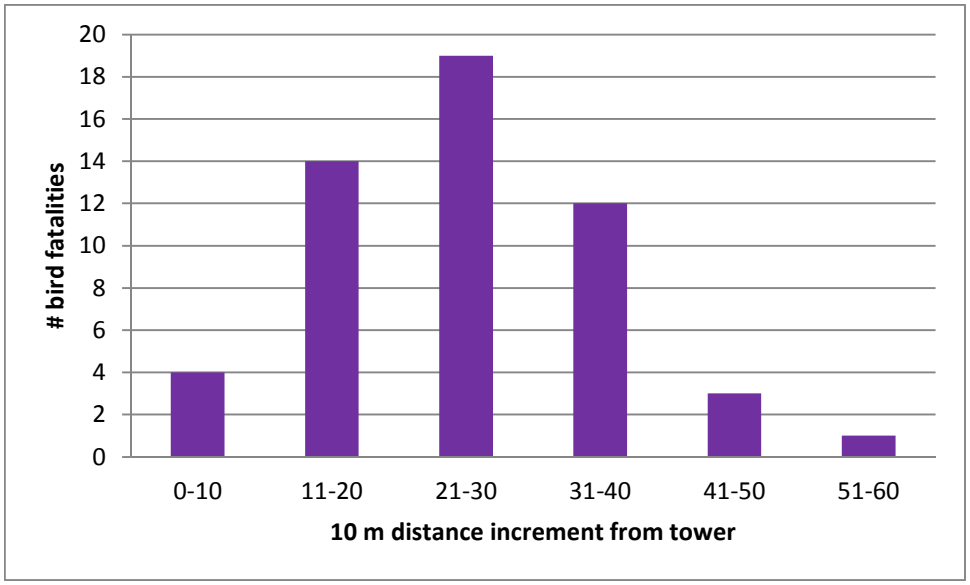

Figure 2-3. Distribution of bird carcasses found in 10 m distance increments from the towers, Record Hill 2012

Spatial Distribution Statistical Analysis Results

The Chi-square goodness of fit test indicated an uneven distribution of all carcasses, an even distribution of bat carcasses, and an uneven distribution of bird carcasses at individual search turbines.

<u>Chi-square tests for evenness:</u>

Bat: chi-square = 31.0, p = 0.07366 (even)

Bird: chi-square = 51.0, p = 0.00026 (uneven)

All carcasses: chi-square = 63.5, p = 0.0000 (uneven)

The Kruskal Wallis test indicated no significant difference between all carcasses or bat carcasses at turbines in different topographical settings. There was a significant difference in the locations of bird carcasses among turbines in different topographical settings.

<u>Kruskal Wallis test</u>

Fatalities observed at saddle, crest, and mid-slope turbines:

Bat: Chi-square = 1.4167, p = 0.4925 (no difference)

Bird: Chi-square = 7.7943, p = 0.0203 (significant)

All carcasses: Chi-square = 5.5302, p = 0.06297 (no difference)

The Wilcoxon Rank Sum tests indicated no statistical difference between the numbers of carcasses at FAA lit vs. unlit turbines, or the numbers of carcasses at mid- vs. end-string turbines.

Wilcoxon Rank Sum tests

Fatalities observed at lit and unlit turbines:

Bat: W = 64.5, p = 0.5761 (no difference)

Bird: W = 76.5, p = 0.1581 (no difference)

All carcasses: W = 67.5, p = 0.448 (no difference)

Fatalities observed at mid string versus end string turbines.

Bat: W = 52.5, p = 1.00 (no difference)

Bird: W = 62.0, p = 0.5118 (no difference)

All carcasses: W = 51.0, p = 0.9432 (no difference)

Because there was a relationship between bird fatalities and topography, the numbers of bird and bat fatalities at different turbines were compared to turbine elevations (Figure 2-4). There appears to be a positive relationship between the numbers of bird fatalities found at turbines located at greatest elevations. When comparing the numbers of birds found, 59% (n=26) were found at turbines located on crests, 32% (n=14) were found on turbines located in saddles, and 9% (n=4) were found at mid-slope turbines.

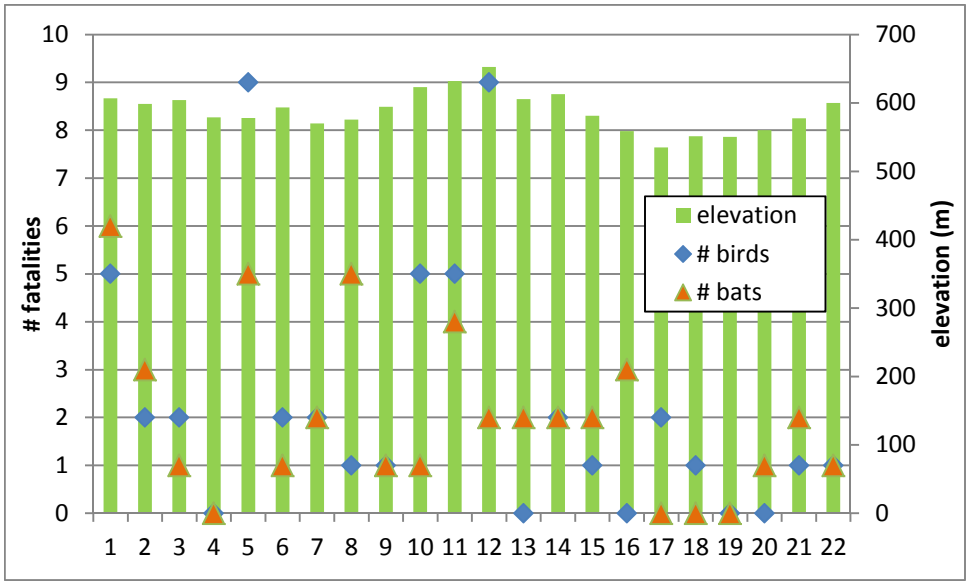

Figure 2-4. Turbine elevations and the number of bird and bat fatalities found, Record Hill 2012

There appeared to be no positive relationship between the size of search plot area and the numbers of carcasses found.

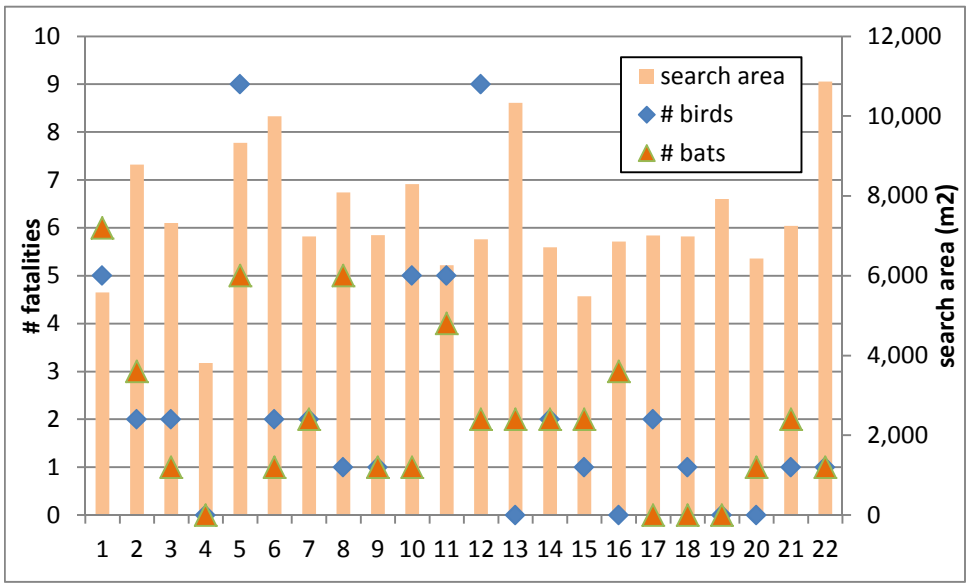

Figure 2-5. Turbine search plot size and the number of bird and bat fatalities found, Record Hill 2012

2.3.6 Searcher Efficiency Results

Thirty-four carcasses were placed to test searcher efficiency: 13 bats and 21 small birds. Bat species placed for trials included hoary bat, red bat, silver-haired bat (*Lasionycteris noctivagans*), and little brown bat (*Myotis lucifugus*). Bird species placed in trials included native passerine species (i.e. primarily warblers) and ruffed grouse. Three birds were scavenged during trials, one remained mostly intact and was counted but the other 2 birds were completely removed and were therefore not included in the calculation of searcher efficiency. Therefore, there were 19 birds available for the calculation of searcher efficiency.

Table 2-5. Searcher efficiency rate (SE) for bats, 95% confidence intervals

No. carcasses placed	13
No. carcasses found	8
mean SE	0.62
lower SE	0.38
upper SE	0.85

Table 2-6. Searcher efficiency rate (SE) for birds, 95% confidence intervals

No. carcasses placed	19
No. carcasses found	9
mean SE	0.47
lower SE	0.26
upper SE	0.68

2.3.7 Carcass Persistence Results

Thirty-three carcasses were placed to test carcass persistence: 14 bats and 19 birds. Bat species placed for trials included hoary bat, red bat, and silver-haired bat. Bird species placed in trials included native passerine species (i.e. primarily warblers) and ruffed grouse. Results indicated that 51% of bats and 60% of birds remained available to be found during search intervals (Tables 2-7 and 2-8).

Table 2-7. Bat carcass persistence estimates and confidence intervals for r (CP)

No. placed	14
mean no. days CP	3.87
lower no. days CP	0.48
upper no. days CP	10.49
CP rate	0.51
CP lower	0.08
CP upper	0.76

Table 2-8. Bird carcass persistence estimates and confidence intervals for r (CP)

No. placed	19
mean no. days CP	3.58
lower no. days CP	1.94
upper no. days CP	5.76
CP rate	0.60
CP lower	0.42
CO upper	0.72

2.3.7.1 Game Camera Results

The game cameras provided some insight into the species composition of scavengers on-site. Example pictures of potential and confirmed scavengers are provided in Appendix B Photos 1 through 7. Potential and confirmed scavengers at the Project based on pictures, visual observations, and tracks include red fox (*Vulpes vulpes*), common raven (*Corvus corax*), and black bear (*Ursus americanus*). There were also videos of fox caught in the act of eating trial carcasses during Trials 2 and 3. Another potential scavenger captured in photos included snowshoe hair (*Lepus americanus*). Wild turkeys (*Meleagris gallopavo*) were captured in photos and video pecking at a trial carcass, but they did not appear to scavenge the carcasses.

2.3.8 Estimate of Fatality Rates

Huso Estimator

Tables 2-9, 2-10, and 2-11 provide the estimates of bird and bat fatality per turbine per study year and per MW per study year based on the Huso Estimator, a) with no search area corrections and b) with search area corrections. Note that the 2 birds found at the met tower were not included in fatality estimates.

Table 2-9. Record Hill 2012 annual* estimates of bird and bat mortality based on the Huso Estimator (no search area correction factor)

Result	**Bats**	**Birds**
No. carcasses found	44	44
Adjusted mortality/study year	**146**	**164**
95% CI upper	73	88
95% CI lower	1036	379
Adjusted fatality/turbine/study year	**6.60**	**7.41**
95% CI upper	3.29	4.00
95% CI lower	47.08	17.22
Adjusted fatality/MW/study year	**2.89**	**3.24**
*Study year does not include searches from June 8 to July 6.		

Search area corrections

Table 2-10 provides the area corrected number of bat and bird carcasses per turbine, as well as the carcass density weighted proportion area searched values for each turbine.

Table 2-10. Search area corrections applied to each turbine, Record Hill 2012

Turbine #	# bats found	# corrected bats	density weighted proportion area searched value - bats	# birds found	# corrected birds	density weighted proportion area searched value - birds
1	6	6.204	0.967	5	5.000	1.000
2	3	3.000	1.000	2	2.000	1.000
3	1	1.000	1.000	2	2.667	0.750
4	0	0.000	n/a	0	0.000	n/a
5	5	5.001	1.000	9	9.000	1.000
6	1	1.000	1.000	2	2.000	1.000
7	2	2.000	1.000	2	2.000	1.000
8	5	5.818	0.859	1	1.000	1.000
9	1	1.00	1.000	1	1.000	1.000
10	1	1.00	1.000	5	9.205	0.543
11	4	4.13	0.970	5	5.158	0.969
12	2	2.00	1.000	2	3.083	0.649
13	2	2.00	1.000	0	0.000	n/a
14	2	2.00	1.000	2	2.136	0.936
15	2	2.00	1.000	1	1.042	0.960
16	3	3.00	1.000	0	0.000	n/a
17	0	0.00	n/a	2	2.000	1.000
18	0	0.00	n/a	1	1.000	1.000
19	0	0.00	n/a	0	0.000	n/a
20	1	1.00	1.000	0	0.000	n/a
21	2	2.00	1.000	1	1.000	1.000
22	1	1.00	1.000	1	1.000	1.000
TOTAL	**44**	**45**		**44**	**50**	

Table 2-11. Record Hill 2012 annual* estimates of bird and bat mortality based on the Huso Estimator (with search area corrections)

Result	Bats	Birds
No. carcasses found	44	44
Adjusted mortality/study year	**150**	**187**
95% CI upper	75	98
95% CI lower	1094	415
Adjusted fatality/turbine/study year	**6.78**	**8.46**
95% CI upper	3.40	4.45
95% CI lower	49.71	18.83
Adjusted fatality/MW/study year	**2.96**	**3.70**
*Study year does not include searches from June 8 to July 6.		

2.4 DISCUSSION

2.4.1 Trends in Timing of Fatality

During the 2012 study, the 89% of bird fatalities were found in the spring. While these results are somewhat atypical compared to the timing of bird fatalities found during previous years at other wind projects in the region, this trend is consistent with the results from other Projects in Maine for which 2012 fatality surveys were conducted. At the Stetson Mountain II and Rollins Wind Projects near Lincoln, Maine the majority of carcasses were also found in the spring (Stantec in prep). The influences behind the increased bird collision risk during the spring at the Project, and at other projects in Maine during 2012 are beyond the scope of this study; however, relevant factors likely include unusually warm spring temperatures and other weather conditions such as frequent fog and rain during the spring. Many of the nights during which bird collisions were believed to have occurred at Record Hill during 2012 (45% of nights when collision were suspected due to carcass condition), were characterized by inclement weather conditions such as rain, fog, or mist.

Eighty-six percent of bats were found in the late-summer and fall, consistent with the results of other studies in North America (Kunz et al. 2007).

There were no carcasses found after September 12. However, scavenger activity at the site increased as the study year progressed: during the spring, summer, and fall the average length of persistence for trial carcasses was 7.6 days, 2.3 days, and 1.08 days, respectively.

2.4.2 Trends in Spatial Distribution of Carcasses

Among individual turbines, there was an even and uneven distribution of bat and bird carcasses, respectively. There appeared to be no relationship between search plot size and the number of carcasses found. There was a relationship between bird carcasses and topography and

elevation; more birds were found at turbines located on crests and at turbines located at higher elevations. There were 9 birds found at both turbines 5 and 12. Turbine 12 is located at the highest elevation; however, it was also where raptor surveys were conducted and 7 birds were found incidentally at this turbine during 2 site visits for raptor surveys. Turbine 5 was located in a depression or saddle. Given that the project's permit requires fatality monitoring in years 1, 3, and 5 of project operation, it is recommended that the distribution of carcasses among individual turbines during future monitoring at the site be compared to the 2012 results to investigate if there are repeated trends in the number of fatalities found at individual turbines among survey years.

Carcass distances and directions from turbines

There were no observable trends in the distribution (azimuths) of bird and bat carcasses within search plots.

Carcasses, particularly large carcasses, can fall substantial distances from towers due to their central mass condensation (Hull and Muir 2010). The results of Hull and Muir's 2010 Monte-Carlo ballistics model of the fall distances of carcasses at modern generation turbines indicates that 99% of all small bird carcasses are found within 71 m of the base of towers, 99% of bats are found within 57 m of towers, 99% of large birds are found within 90 m of towers, and half of all carcasses are found within the first 35 m of towers (Hull and Muir 2010).

The implications of Hull and Muir's 2010 model are generally consistent with the carcass distribution observed at Record Hill. All bats were found within 50 m of turbines and just three bats were found beyond 40 m of turbines. All birds were found within 60 m of turbines with just 4 birds found beyond 40 m of turbines. It should be noted that search plot radii rarely exceeded 63 m, with the exception of the search plot extending out to 80 m on the eastern side of turbine 2 and out to 70 m on the northeast side of turbine 22. The dimensions of search plots were variable; however, the search area extended out to 63 m on at least one side of most turbines (Appendix A Figures 1-4). The methods used for search area corrections are designed to account for any carcasses that may have fallen within truncated portions of a plot out to a distance equivalent to the maximum search distance on any side of that turbine. These methods cannot account for carcasses that may have fallen beyond the maximum search distance at each tower. However, available studies suggest that the majority of carcasses would be expected to fall within search plots, even within the restricted size of search plots of turbines on forested ridgelines (Fiedler et al. 2007). Other examples include the Meyersdale project in Pennsylvania where Kerns and Kerlinger (2004) reported that the majority of bird and bat fatalities were found within about 30 m (100 ft) of the turbine bases, and Kerns et al. (2005) reported that greater than 80 percent of bat fatalities were found within 40 m (131 ft) of turbines at Meyersdale, PA and Mountaineer, WV. These trends and the carcass distance distributions observed at Record Hill suggest that few carcasses may have landed beyond 63 m from turbines.

2.4.3 Bird and Bat Mortality Estimates

There are a growing number of bird and bat fatality estimator methods becoming available. At this point, no method is considered superior to the others. This estimator was chosen because it is one of the more recent methods under development.

One difference between the Huso estimator and some of the other available estimators is how variance and confidence intervals are calculated. The Huso estimator uses bootstrapping to calculate variance and confidence intervals. Huso suggests bootstrapping is appropriate when some variables of the model (i.e., observer detection rates, carcass persistence rates, proportion of carcasses within searchable areas) are unknown and must be estimated (Huso 2010). For mortality surveys at wind projects, these variables are almost always unknown.

The Huso Estimator can directly account for the distribution of carcasses across variable ground cover (i.e., carcasses found within different visibility classes) by adding covariates to the model. The Huso Estimator requires a sample size of at least 10 carcasses per covariate in order to incorporate them into the model. However, investigating searcher efficiency among visibility classes was not a priority at the Record Hill Project as the ground cover within plots was virtually uniform.

There is some degree of bias associated with all available mortality estimators due to the unknown variables that that are estimated and factored into the estimates of mortality. Huso (2010) indicates that her estimator has less biased results when searcher efficiency and carcass removal rates remain constant over time. However when these rates vary over time, her estimator, like most other available estimators, results in greater bias. Huso (2010) indicates that for sites with short persistence time (< 4.2 days) and short search intervals (1-7 days), her estimator tends to overestimate mortality. At Record Hill, there were short carcass persistence intervals for bats (3.87 days) and birds (3.58 days), and a relatively short search interval (approximately 5 days); therefore, the estimates of mortality for the Record Hill Project are likely overestimated by the Huso Estimator.

Regional comparison of fatality estimates

It should be noted that other studies in the region used a variety of different fatality estimators. Further, search plot size at different projects was variable (i.e., studies in relatively flat agricultural areas vs. studies on forested ridge tops) and some studies included search area corrections, while others did not. However, all of these studies included adjustments for searcher efficiency and carcass persistence. Direct comparisons of mortality estimates among sites should be made with caution.

When comparing the 2012 Record Hill bat mortality estimate (with search area corrections) to recent estimates from other projects in the eastern U.S., the estimate of bat mortality (6.78 bats/turbine/year) is within the range of these other studies (range = 0.43 to 63.90

bats/turbine/year) (Table 2-12). The Record Hill bat mortality rate is below the median estimate (median = 8.92 bats/turbine/year) of mortality based on these other studies.

When comparing the 2012 Record Hill bird mortality estimate (with search area corrections) to recent estimates from other projects, the estimate of bird mortality (8.46 birds/turbine/year) is within the range of these other studies (range = 1.76 to 9.48 birds/turbine/year). The Record Hill bird mortality rate is above the median estimate (median = 3.26 birds/turbine/year).

Table 2-12. Comparison of bat and bird mortality at existing wind farms in the eastern U.S.

Site	Habitat type (#	Dates surveyed	Search interval	# BATS	Estimated	# BIRDS	Estimated	Reference
Searsburg, Vermont	forested (11)	June 30 - Oct 18, 1997	11 total (4 per search) 2 to 6 days per month	0	n/a	0	n/a	Kerlinger, P. 2002. An Assessment of the Impacts of Green Mountain Power Corporation's Wind Power Facility on Breeding and Migrating Birds in Searsburg, Vermont. Prepared for the Vermont Department of Public Service Montpelier, Vermont. Subcontractor report for the National Renewable Energy Laboratory NREL/SR-500-28591.
Somerset County, Pennsylvania	agricultural (8)	2000 (12 months)	n/a	0	n/a	0	n/a	Kerlinger, P. 2006. Supplement to the Phase I Avian Risk Assessment and Breeding Bird Study for the Deerfield Wind Project, Bennington County, Vermont. Prepared for Deerfield Wind, LLC.
Mountaineer, West Virginia	forested ridgeline (44)	April 4 - Nov 11, 2003	2x per week	475	47.53 (2092)	69*	4.04 (178 + 33 due to substation lighting)	Kerns, J., and P. Kerlinger. 2004. A study of bird and bat collision fatalities at the Mountaineer Wind Energy Center, Tucker County, West Virginia, USA: annual report for 2003. <http://www.responsiblewind.org/docs/MountaineerFinalAvianRpt3-15-04PKJK.pdf>. (Accessed 30 September 2007).
Mountaineer, West Virginia	forested ridgeline (44)	July 31- Sept 11, 2004	22 daily, 22 weekly	398 (68)	38 (1364-1980)	15 (n/a)	n/a	Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn. 2005. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. Bats and Wind Energy Cooperative.
Meyersdale, Pennsylvania	forested ridgeline (20)	Aug 2 - Sept 13, 2004	10 daily, 10 weekly	262 (37)	25 (400-660)	13 (4)	n/a	Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn. 2005. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. Bats and Wind Energy Cooperative.
Buffalo Mtn, Tennessee	reclaimed mine on ridge (18)	April - Dec 10, 2005	18 of 18 every week, every 2 weeks, or every 2-5 days	243 (14)	63.9 (1,149)	9 (2)	1.8 (112)	Fiedler, J.K., T.H. Henry, R.D. Tankersley, and C.P. Nicholson 2007. Results of Bat and Bird Mortality Monitoring at the Expanded Buffalo Mountain Windfarm, 2005 June 28, 2007. Prepared for Tennessee Valley Authority.
Maple Ridge, New York	woodland, grassland, agricultural (120)	June 17 - Nov 15, 2006	10 every 3-days, 30 7-days, 10 daily	326 (58)	11.39-20.31 (1367-2437.2)	123 (15)	3.10-9.48 (372-1138)	Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2007. Annual report for the Maple Ridge wind power project post-construction bird and bat fatality study—2006. Annual report prepared for PPM Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA. http://www.wind-watch.org/documents/wp-content/uploads/maple_ridge_report_2006_final.pdf Accessed 1 December 2007.
Maple Ridge, New York	woodland, grassland, agricultural (195)	April 30 - Nov 14, 2007	64 weekly	202 (81)	15.54-18.53 (3030-3614)	64 (32)	5.67-6.31 (1106-1230)	Jain, A. P. Kerlinger, R. Curry, and L. Slobodnik. 2008. Annual report for the Maple Ridge wind power project post-construction bird and bat fatality study—2007. Annual report prepared for PPM Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA.
Maple Ridge, New York	woodland, grassland, agricultural (195)	April 15 - Nov 9, 2008	64 weekly	140 (76)	8.18 - 8.92 (1595-1739)	74 (23)	3.42-3.76 (667-733)	Jain, A. P. Kerlinger, R. Curry, and L. Slobodnik. 2009. Annual report for the Maple Ridge wind power project post-construction bird and bat fatality study—2007. Annual report prepared for PPM Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA.
Mars Hill, Maine	forested ridgeline (28)	April 23-June 3, July 15-Sept 23, 2007	2 of 28 daily, 28 of 28 weekly, seasonal dog searches	22 (2)	0.43-4.4 (12.1-122.5)	19 (3)	0.44-2.5 (27-69)	Stantec Consulting. 2008. Spring, Summer, and Fall Post-construction Bird and Bat Mortality Study at the Mars Hill Wind Farm, Maine. Unpublished report prepared for UPC Wind Management, LLC.
Mars Hill, Maine	forested ridgeline (28)	April 19 - June 6, July 15-Oct 8, 2008	28 of 28 weekly, seasonal dog searches	5 (0)	0.17-0.68 (5-19)	17(4)	2.4-2.65 (57-74)	Stantec Consulting. 2009. Post-construction Monitoring at the Mars Hill Wind Farm, Maine – Year 2. Unpublished report prepared for First Wind Management, LLC.
Munnsville, New York	agricultural forested uplands (23)	April 15-Nov 15, 2008	12 of 23 weekly, seasonal dog searches	9 (1)	0.70-2.90 (16-67)	7 (3)	1.71-2.22 (39-51)	Stantec Consulting. 2009. Post-construction monitoring at the Munnsville Wind Farm, New York, 2008. Prepared for E.ON Climate and Renewables.
Mount Storm, West Virginia	forested ridgeline (82)	July 18 - Oct 17, 2008	18 weekly, 9 daily	182 (27)	daily: 24.21 (1985) weekly: 7.76 (636)	29 (8)	2.41-3.81 (198-312)	Young, D.P., W.P. Erickson, K. Bay, S. Normani, W. Tidhar. 2009. Mount Storm Wind Energy Facility, Phase 1: Post-construction Avian and Bat Monitoring. Prepared for: NedPower Mount Storm, LLC.
Mount Storm, West Virginia	forested ridgeline (82)	July-October 2010	25 daily	308 (73)	22.39 (1836)	36 (11)	2.77 (227)	Young, D.P., S. Nomani, W. Tidhar, and K. Bay. 2010. Mount Storm Wind Energy Facility Post-construction Avian and Bat Monitoring, July-October 2010. Prepared for NedPower Mount Storm, LLC.
Casselman, Somerset Cty, PA	forested ridge, grassland mine ridge (23)	July 27 - October 9, 2008	22 daily	32***	24.2 (557)	N/A	N/A	Arnett, E.B., M. Schirmacher, M.P. Huso, J.P. Hayes. 2010. Effectiveness of changing wind turbine cut-in speed to reduce bat fatalities at wind facilities. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA.
Casselman, Somerset Cty, PA	forested ridge, grassland mine ridge (23)	July 26 - October 8, 2009	22 daily	39***	17.4 (400)	N/A	N/A	Arnett, E.B., M. Schirmacher, M.P. Huso, J.P. Hayes. 2010. Effectiveness of changing wind turbine cut-in speed to reduce bat fatalities at wind facilities. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA.
Clinton, New York	agricultural, woodland (67)	April 26 to October 13, 2008	8 daily, 8 every 3-days, 7 weekly	39 (14)	daily: 5.45 (365); 3-day: 4.81 (322); weekly: 3.76 (252)	14 (9)	daily: 1.43 (956); 3-day: 3.26 (218); weekly: 2.48 (166)	Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, J. Histed, and J. Meacham. 2009. Annual Report for the Noble Clinton Windpark, LLC. Postconstruction Bird and Bat Fatality Study – 2008. Prepared by Curry and Kerlinger, LLC.
Clinton, New York	agricultural, woodland (67)	April 15 to November 15, 2009	8 daily, 15 weekly	36 (6)	daily: 9.72 (651); weekly: 5.16 (3.46)	16 (8)	daily: 1.50 (101); weekly: 1.76 (118)	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2010. Annual Report for the Noble Clinton Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC.
Ellenburg, New York	agricultural, woodland (54)	April 28 to Oct 13, 2008	6 daily, 6 every 3-days, 6 every 7-days	34 (25)	daily: 8.17 (441); 3-day: 6.94 (375); weekly: 4.19 (226)	12 (10)	daily: 2.09 (113); 3-day: 1.37 (74); weekly: 1.18 (64)	Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, A. Fuerst, and C. Hansen. 2009. Annual Report for the Noble Ellenburg Windpark, LLC. Postconstruction Bird and Bat Fatality Study – 2008. Prepared by Curry and Kerlinger, LLC.
Ellenburg, New York	agricultural, woodland (54)	April 15 to November 15, 2009	6 daily, 12 weekly	28 (4)	daily: 8.01 (433); weekly: 3.70 (200)	19 (2)	daily: 5.69 (307); weekly: 2.29 (124)	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2010. Annual Report for the Noble Ellenburg Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC.
Bliss, New York	agricultural, woodland (67)	April 21 to Nov 14, 2008	8 daily, 8 every 3-days, 7 weekly	74 (15)	daily: 7.58 (508); 3-day:14.66 (983); weekly: 13.01 (872)	20 (7)	daily: 4.30 (288); 3-day: 0.66 (44); weekly: 0.74 (50)	Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, J. Quant, D. Pursell. 2009. Annual Report for the Noble Bliss Windpark, LLC. Postconstruction Bird and Bat Fatality Study – 2008. Prepared by Curry and Kerlinger, LLC.
Bliss, New York	agricultural, woodland (67)	April 15 to November 15, 2009	8 daily, 15 weekly	36 (0)	daily: 8.24 (552); weekly: 4.46 (299)	25 (7)	daily: 4.45 (298); weekly: 2.87 (192)	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2010. Annual Report for the Noble Bliss Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC.
Altona, New York	primarily woodlots (65)	April 26 to October 15, 2010	22 weekly, 8 daily from July 18 to Sept 18	24 (7)	daily: 6.51 (423); weekly: 3.87 (252)	14 (6)	daily: 1.55 (101); weekly: 2.76 (180)	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2011. Annual Report for the Noble Altona Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2010. Prepared for Noble Environmental Power, LLC.
Cohocton and Dutch Hill, NY	agricultural, woodland (50)	April 15 to Nov 15, 2009	5 daily, 12 weekly	62 (7)	daily: 40.4 (2002); weekly: 13.8 (804)	15 (3)	2.9 - 4.7 (147-235)	Stantec Consulting. 2010. Cohocton and Dutch Hill Wind FarmsYear 1 Post-Construction Monitoring Report, 2009 for the Cohocton and Dutch Hill Wind Farms In Cohocton, New York. Prepared for Canandaigua Power Partners, LLC and Canandaigua Power Partners II, LLC.
Cohocton and Dutch Hill, NY	agricultural, woodland (50)	April 26 to October 22, 2010	17 weekly except when 12 weekly and 5 daily from July 15-Sept 17	63 (5)	daily: 25.62 (1281); weekly 1: 5.04 (252); weekly 2: 10.44 (522)	9 (1)	daily: 2.06 (103); weekly 1: 0.82 (41); weekly 2: 1.16 (58)	Stantec Consulting. 2011. Cohocton and Dutch Hill Wind FarmsYear 2 Post-Construction Monitoring Report, 2010 for the Cohocton and Dutch Hill Wind Farms In Cohocton, New York. Prepared for Canandaigua Power Partners, LLC and Canandaigua Power Partners II, LLC.
Wethersfield, NY	agricultural, woodlots (84)	April 15 to Oct 15, 2010	28 weekly	62 (13)	24.45 (2054)	11 (7)	2.55 (214)	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K., Harte, A. 2011. Annual Report for the Noble Wethersfield Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2010. Prepared for Noble Environmental Power, LLC.
Chateaugay, NY	agricultural, woodlots (71)	April 26 to Oct 15, 2010	24 weekly	22 (7)	3.66 (260)	19 (9)	2.40 (170)	Jain, A., Kerlinger, P., Slobodnik, L., Curry, R., Russel, K. 2011. Annual Report for the Noble Chateaugay Windpark, LLC Post-Construction Bird and Bat Fatality Study - 2010. Prepared for Noble Environmental Power, LLC.
Lempster, NH	forested ridgeline (12)	April 15-June 1; July 15-Oct 31, 2009	4 daily	10 (2)	spring: 0.58 (7); fall: 5.51 (66)	9 (4)	spring: 0.80 (10); fall: 5.95 (71)	Tidhar, D., W. Tidhar, and M. Sonnenberg. 2010. Post-Construction Fatality Surveys for Lempster Wind Project. Prepared for Lempster Wind, LLC.
Lempster, NH	forested ridgeline (12)	April 15-June 1; July 15-Oct 31, 2010	12 weekly	14 (5)	spring (0); fall 7.13 (86)	11 (0)	spring: 1.16 (14); fall: 4.12 (49)	Tidhar, D., W. Tidhar, L. McManus, and Z. Courage. 2011. 2010 Post-Construction Fatality Surveys for Lempster Wind Project. Prepared for Lempster Wind, LLC.
Stetson Mountain I, Maine	forested ridgeline (38)	April 20 to Oct 21, 2009	19 weekly	5 (0)	2.11 (80)	30 (9)	4.03 (153)	Stantec Consulting. 2010. Stetson I Mountain Wind Project, Year 1 Post-Construction Monitoring Report, 2009. Prepared for First Wind Management, LLC.
Stetson Mountain I, Maine	forested ridgeline (38)	April 18 to October 21, 2011	19 weekly	4 (0)	0.43 (16)	7 (0)	1.77 (67)	Normandeau Associates. 2010. Year 3 Post-construction avian and bat casualty monitoring at the Stetson I Wind Farm. Prepared for First Wind, LLC.
Stetson Mountain II, Maine	forested ridgeline (17)	April 19 to Oct 15, 2010	17 weekly	14 (0)	2.48 (42.12)	11 (0)	2.14 (36.41)	Normandeau Associates. 2010. Stetson Mountain II Wind Project Year 1 Post-Construction Avian and Bat Mortality Monitoring. Prepared for First Wind, LLC.
Kibby Mountain, Maine	forested ridgeline (44)	May 2 to June 20; July 11 to October 14, 2011	22 3 times every 2 wks	6 (3)	spring: (0); fall: 0.37 (16)	17 (4)	spring: 0.72 (32); fall: 0.29 (12)	Stantec Consulting. 2011. 2011 Post-Construction Monitoring Report Kibby Wind Power Project, Franklin County, Maine. Prepared for TransCanada Hydro Northeast, Inc.
Rollins, Maine	forested ridgeline (40)	April 15 to October 15, 2012	20 weekly	2 (0)	0.18 (7.2)****	9 (7)	2.94 (118)***	Stantec Consulting. 2012. RollinsWind Project Post-Construction Monitoring Report, 2012. Prepared for First Wind, LLC.
Stetson II, Maine	forested ridgeline (17)	April 15 to October 15, 2012	17 weekly	4 (0)	2.06 (36)****	5 (0)	2.83 (49)***	Stantec Consulting. 2012. Stetson II Wind Project Post-Construction Monitoring Report, 2012. Prepared for First Wind, LLC.
Record Hill, Maine	forested ridgeline (22)	April 15 to June 7 and July 7 to October 15, 2012	22 3 times every 2 wks	44 (0)	6.78 (150)****	46 (7)	8.46 (187)****	*this report*

*33 birds found on May 23, 2003 at turbines near a substation and at substation associated with sodium vapor lights
**Results of spring interim report, study period April 20 to June 1.
***Fresh bats found at curtailment treatment turbines reported only.
****Based on the Huso fatality estimator with area corrections.

High scavenger activity particularly during the fall likely influenced the estimates of mortality at Record Hill. The game cameras documented red fox scavenging all carcasses within 2 days during one of the fall carcass persistence trials. There may have been some bias associated with these keen scavengers keying into human scent and the locations of trial carcasses. If fewer carcasses are placed during more frequent trials, we believe there may be less opportunity for scavengers to key into larger numbers of carcasses placed during just a few trials. Also, while efforts were made to reduce human scent during 2012 (i.e., minimal handling of carcasses and use of gloves during carcass placement), greater efforts should be made to reduce human scent leading up to trial carcasses during carcass checks in 2014 (i.e., checking on carcasses from greater distances when possible, and tossing carcasses from greater distances during trial set-up). Accurate estimates of carcass persistence are crucial to generating accurate estimates of fatality. As indicated previously, Huso (2010) indicates that when scavenging rates are not constant during the study, fatality estimates can result in overestimates of fatality.

Searcher efficiency rates for the Project were comparable to other projects in the region at approximately 55% for bird and bat carcasses combined (searcher efficiency rates at other projects in Maine are approximately 50%). Visibility was high in search plots as the ground cover was bare rock and gravel in all plots. It should also be noted that search plot size at the Record Hill Project was relatively large compared to other Projects in Maine and New Hampshire. Because the turbines are 126.5 m (taller than the typical 119 m tall turbines), the area cleared for turbine laydown consisted, on average, of a 96 m diameter plot. The laydown areas and search plots at other projects in the region typically consist of a 75 m diameter. Further, the turbine laydown areas at Record Hill were generally centered on the turbine base as opposed to having a relatively large plot on one side of the turbine with forest edge on the other side. Therefore, there may have been more opportunity to find more carcasses at Record Hill than at other Projects in the region.

2.4.4 Species Mortality

Tree-roosting bat mortality

Bat fatalities found at Record Hill consisted of tree roosting bat species. This species group is most commonly found during wind fatality studies in North America (Kunz et al. 2007, Arnett et al. 2008, Baerwald and Barclay 2009). The Record Hill mortality estimate is within the range of bat fatalities reported at other recent wind projects in the east. Little is known about the population size or status trends of hoary bats; eastern red bats were once considered one of the most abundant bats within their range but their population is suspected to have declined substantially over the past 100 years; silver-haired bats are considered one of the most abundant bats in forested areas of northern North America but their status has not been investigated (England et al. 2001). These species are listed as Special Concern in Maine. It is unclear how the level of bat mortality at Record Hill compares to other human induced sources of bat mortality including destruction of habitat, collisions with other manmade structures, and exposure to agricultural and industrial chemicals.

Passerines

Nocturnal migrant passerines are the group of birds most commonly found at wind projects (NRC 2007). This group of birds is susceptible to collisions with manmade structures during nocturnal migration, particularly during inclement weather conditions when birds may be flying at lower heights and may become disoriented. The loss of 8.46 birds/turbine/year or 187 birds is relatively small considering the regional populations of the species of birds that were most commonly found at Record Hill: magnolia warbler (n=8, 15%), golden-crowned kinglet (n=6, 11%), and red-eyed vireo (n=5, 9%). The Partners in Flight (PIF) Land-based Bird Population Estimates Database (Available at http://www.rmbo.org/pif_db/laped/about.aspx) indicates that the North American populations of these species are estimated at 30 million, 30 million, and 140 million, respectively. Further, impacts associated with wind power remain relatively low compared to other sources of human induced mortality, including collisions with other manmade structures, destruction of habitat, exposure to chemicals, and predation by domestic and feral cats. For example, a recent study has indicated that previous estimates of bird mortality due to free-ranging cats were substantially underestimated and the revised estimate is 1.4 to 3.7 billion birds per year in the U.S. alone (Loss 2012).

3.0 Acoustic Bat Survey

3.1 INTRODUCTION

Eight species of bats occur in Maine, based upon their normal geographical range. These are the little brown bat (*Myotis lucifugus*), northern long-eared bat (*M. septentrionalis*), eastern small-footed bat (*M. leibii*), silver-haired bat (*Lasionycteris noctivagans*), tri-colored bat (*Perimyotis subflavus*), big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), and hoary bat (*L. cinereus*) (BCI 2001). Of these, all but the big brown bat are state-listed as Species of Special Concern (MDIFW 2009).

Bats use high frequency echolocation to maneuver through the landscape during migration or in search of food and water. Although echolocation sounds produced by bats fall above the range of human hearing, electronic recording equipment can be used to listen in on these high frequency calls. Acoustic sampling of bat activity has become a standard tool of pre- and post-construction surveys for wind-energy developments. Acoustic sampling allows for simultaneous data collection at varying heights above ground level and across long time periods (Kunz et al. 2007). These surveys can provide insight into altitudinal and seasonal patterns of bat activity. While this type of data collection cannot determine the number of individuals found in an area, and is associated with several major assumptions (Hayes 2000), it can be used to examine activity trends for certain species or species groups.

3.2 METHODS

3.2.1 Data Collection

Anabat detectors were selected for data collection based upon their widespread use for this type of survey, their ability to be deployed for long periods of time, and their ability to detect a broad frequency range, which allows detection of all species of bats which could occur in the Project area. Anabat detectors are frequency division detectors, dividing the frequency of echolocation sounds made by bats by a factor of 16, and then recording these sounds onto removable compact flash cards for subsequent analysis. Detectors were programmed to begin monitoring at 19:00 hours each night and end monitoring at 08:00 hours each morning. The audio sensitivity setting of each Anabat system was set between 6 and 7 (on a scale of 1 to 10) to maximize sensitivity while limiting ambient background noise and interference.

Each Anabat detector was powered by 12-volt batteries charged by solar panels. Each solar-powered Anabat system was deployed in waterproof housing enabling the detector to record while unattended for the duration of the survey. The housing suspends the Anabat microphone downward to give maximum protection from precipitation. To compensate for the downward position, a curved plastic joint was used to funnel sound into the downward-facing microphone, allowing the microphone to record the airspace horizontally surrounding the detector.

3.2.2 Site Selection

Acoustic survey sites were chosen to sample bat activity throughout the Project area and in the vicinity of turbines included in the fatality study. All detectors were deployed at or below tree canopy height where data collected can provide information regarding: (1) resident bat species that generally forage close to, or below tree canopy, and (2) species presence and activity patterns below tree canopy height during migratory periods when the risk of collision is greatest (Kunz et al. 2007).

On April 16, 2012 a detector was deployed at a height of approximately 2 m in a tree on the edge of the turbine pad area at Turbine 1 ('Turbine 1' detector; Figure 3-1). The tree was located at an elevation of approximately 625 m (2,050 ft) on a slope approximately 20 m (66 ft) above the ground level of the turbine pad. The forest composition along the edge of the turbine pad is made up of even-aged, second growth hardwoods. The forest is comprised dominantly of beech (*Fagus spp*.) and maple (*Acer spp.)*, with scattered snags dispersed throughout.

Figure 3-1. Turbine 1 detector at the Record Hill Wind Project, 2012.

On April 17, 2012 a detector was deployed at a height of approximately 10 m (32 ft) in a tree on the edge of the turbine pad area at Turbine 12 ('Turbine 12' detector; Figure 3-2). The tree was located at an elevation of approximately 655 m (2,149 ft). This location was at the highest elevation in the Project area. The forest composition along the edge of the turbine pad is made

up of even-aged, second growth softwoods dominated by spruce (*Picea spp*.) with snags dispersed throughout.

Figure 3-2. Turbine 12 detector at the Record Hill Wind Project, 2012.

On April 18, 2012 a detector was deployed at a height of approximately 5 m (16 ft) in a tree on the edge of the turbine pad area at Turbine 17 ('Turbine 17' detector; Figure 3-3). The tree was located on top of a cliff 10 m above the turbine pad ground level at an elevation of approximately 535 m (1,755 ft). The forest composition along the edge of the turbine pad is made up of even-aged, second growth hardwoods. The forest is dominantly beech and maple, with scattered snags dispersed throughout.

Figure 3-3. Turbine 17 detector at the Record Hill Wind Project, 2012.

On April 18, 2012 a detector was deployed at a height of approximately 5 m in a tree located on the edge of the turbine pad area at Turbine 22 ('Turbine 22' detector; Figure 3-4). The tree was located at an elevation of approximately 606 m (1,988 ft). The forest composition along the edge of the turbine pad is made up of even-aged, second growth hardwoods. The forest is dominantly maple, with scattered beech trees and snags dispersed throughout.

Figure 3-4. Turbine 22 detector at the Record Hill Wind Project, 2012.

3.2.3 Data Analysis

Ultrasound recordings of bat echolocation may be broken into recordings of a single bat call or recordings of bat call sequences. A call is a single pulse of sound produced by a bat, while a call sequence is a combination of two or more pulses recorded in an Anabat file. Recordings containing less than two calls were eliminated from analysis as has been done in similar studies (Arnett et al. 2006). Call sequences typically include a series of calls characteristic of normal flight or prey location ("search phase") and capture periods (feeding "buzzes").

Potential call files were extracted from data files using CFCread© software. The default settings for CFCread© were used during this file extraction process, as these settings are recommended for the calls that are characteristic of bats in this region. This software screens all data recorded by the bat detector and extracts call files using a filter. Using the default settings for this initial screen also ensures comparability between data sets. Settings used by the filter include a max TBC (time between calls) of five seconds, a minimum line length of five milliseconds, and a smoothing factor of 50. The smoothing factor refers to whether or not adjacent pixels can be connected with a smooth line. The higher the smoothing factor, the less restrictive the filter is and the more noise files and poor quality call sequences are retained within the data set.

Insect activity, wind, and interference (i.e., static for turbines) can also sometimes produce Anabat files that pass through the initial filter and need to be visually inspected and removed

from the data set. Call sequences are however easily differentiated from other recordings, which typically form a diffuse band of dots at either a constant frequency or widely varying frequency. Consequently, each call file was visually inspected for species identification and to ensure that only bat calls were included in the data set. Because bat activity levels are highly variable among individual nights and individual hours (Hayes 1997, Arnett et al. 2006), detection rates are summarized on both of these temporal scales. Hourly detection rates were summarized by hour after sunset, as recommended by Kunz et al. (2007). Quantitative comparisons among these temporal periods was not attempted because the high amount of variability associated with bat detection would have required much larger sample sizes (Arnett et al. 2006, Hayes 1997).

Bat call sequences were individually marked and categorized by species group, or "guild" based on visual comparison to reference calls. Qualitative visual comparison of recorded call sequences of sufficient length to reference libraries of bat calls allows for relatively accurate identification of bat species (O'Farrell et al. 1999, O'Farrell and Gannon 1999). Call sequences were classified to species whenever possible, based on criteria developed from review of reference calls collected by Chris Corben, the developer of the Anabat system, as well as other bat researchers. However, due to similarity of call signatures between several species, all classified calls have been categorized into the following 5 guilds[4] reflecting the bat community in the region of the Project area:

- **Myotis (MYSP)** – All bats of the genus *Myotis*. While there are some general characteristics believed to be distinctive for several of the species in this genus, these characteristics do not occur consistently enough for any one species to be relied upon at all times when using Anabat recordings. To be conservative, we did not attempt to differentiate among species within this genus.
- **Eastern red bat/tri-colored bat[5] (RBTB)** – Eastern red bats and tri-colored bats. These two species produce calls distinctive to each species. However, significant overlap in the call pulse shape, frequency range, and slope can occur.
- **Big brown bat/silver-haired bat (BBSH)** – Big brown and silver-haired bats. These species' call signatures are often difficult to distinguish and have therefore been included as one guild in this report.
- **Hoary bat (HB)** – Hoary bats. Calls of hoary bats can usually be distinguished from those of big brown and silver-haired bats by minimum frequency extending below 20 kHz or by calls varying widely in minimum frequency across a sequence.
- **Unknown (UNKN)** – All call sequences with less than five calls, or poor quality sequences (those with indistinct call characteristics or overwhelming background static). These sequences were further identified as either "high frequency unknown" (HFUN) for

[4] Gannon et al. 2003 categorized bats into guilds based upon similar minimum frequency and call shape. These guilds were: Unidentified, Myotis, LABO-PESU and EPFU-LANO-LACI. We broke hoary bats out into a separate guild due to the importance of reporting activity patterns of migratory species in the context of wind energy development.
[5] The scientific and common name of the eastern pipistrelle (*Pipistrellus subflavus*) has been changed to the tri-colored bat (*Perimyotis subflavus*).

sequences with a minimum frequency above 30 to 35 kilohertz (kHz), or "low frequency unknown" (LFUN) for sequences with a minimum frequency below 30 to 35 kHz.

For this area, HFUN most likely represents eastern red bats, tri-colored bats and *Myotis* species since these species typically produce ultrasound sequences greater than 30 kHz. Big brown, silver-haired, and hoary bats would be the species in this area typically producing ultrasound sequences of less than 30 kHz and would be the species most likely represented within the LFUN category of call sequences.

This method of guild identification represents a conservative approach to bat call identification. Since some species sometimes produce calls unique only to that species, all calls were identified to the lowest possible taxonomic level before being grouped into the listed guilds. Tables and figures in the body of this report will reflect those guilds. However, since species-specific identification did occur in some cases, each guild will also be briefly discussed with respect to potential species composition of recorded call sequences.

Once identified, call files were categorized into appropriate guilds, and nightly tallies of detected calls were compiled. Mean detection rates (number of recordings per detector-night) for the entire sampling period were calculated for each detector and for all detectors combined. The sunset time was subtracted from the time of recording in order to determine the number of hours after sunset each file was recorded.

3.2.3.1 Weather Data

Temperature (°C) and wind speed (m/s) were collected from the on-site met tower, adjacent to Turbine 7. Temperature and wind speed weather variables were summarized. The nightly mean temperature and wind speed were calculated for each night. Weather data from April 16 through October 23 were available for this report.

3.3 RESULTS

The 4 Project detectors were deployed over 3 days, from April 16 to 18, and operated through October 23. Individual detectors' operational success ranged from 70% to 99%, resulting in an overall success rate of 84% of the survey period, with valid data collected by all detectors for 639 of the 759 sampled calendar nights for all detectors combined. Bats were detected at one or more of the four detectors during 444 (69%) of the 639 detector-nights during the survey period.

Detector success was occasionally limited by equipment failure, therefore it is important to consider the periods when detectors were operating successfully when interpreting results. Figure 3-5 shows the periods when each detector was operating successfully.

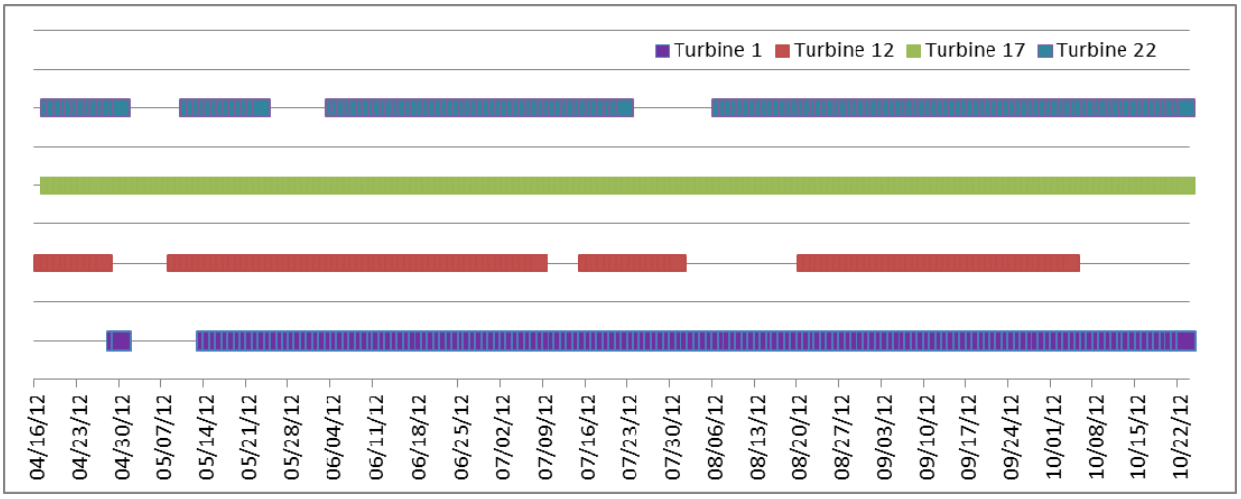

Figure 3-5. Dates of successful operation of detectors at Record Hill, 2012.

During the survey period, a total of 15,724 bat call sequences were recorded by the detectors (Table 3-1) for an overall detection rate of 24.6 bat call sequences per detector-night (calls/detector-night). The Turbine 1 detector recorded the majority of calls recorded by all detectors (52%, n=8,173 calls sequences) with an overall detection rate of 49.5 calls/detector-night; the Turbine 17 detector recorded 4,857 call sequences and a detection rate of 25.8 calls/detector-night; the Turbine 22 detector recorded 1,982 call sequences and a detection rate of 13.0 calls/detector-night; and the Turbine 12 detector recorded 712 call sequences with a detection rate of 5.4 calls/detector-night.

Table 3-1. Summary of bat detector field survey effort and results at Record Hill, 2012.

Location	Dates Deployed	Calendar Nights	Detector-Nights*	Recorded Sequences	Detection Rate **	Maximum Sequences recorded ***
Turbine 1	April 16 to Oct 23	191	165	8173	49.5	557
Turbine 12	April 17 to Oct 23	190	133	712	5.4	137
Turbine 17	April 18 to Oct 23	189	188	4857	25.8	263
Turbine 22	April 18 to Oct 23	189	153	1982	13.0	490
Overall Results		***759***	***639***	***15724***	***24.6***	--

* One detector-night is equal to a one detector successfully operating throughout the night.
** Number of bat echolocation sequences recorded per detector-night.
*** Maximum number of bat passes recorded from any single detector for a detector-night.

3.3.1 Timing of Activity

Activity across the survey period varied among detector locations and was pulsed, with the highest monthly detection rates recorded between June and August (Figure 3-6). The Turbine 1 detector recorded the highest monthly detection rate (103.4 calls/detector night) during the month of June; the Turbine 12 detector recorded the highest monthly detection rate during July (11.9 calls/detector night) (Figure 3-6); the Turbine 17 detector recorded similar detection rates in July and August, with a slightly higher activity rate recorded in August (61.6 calls/detector

night); the Turbine 22 detector recorded the highest rate of activity during the month of August (47.6 calls/detector night). For the entire survey period the largest single night of recorded acoustic activity occurred on June 14 (805 call sequences; Figure 3-7), during a period when all four detectors were operational: of these calls, 80% (n=640) were hoary bat (LACI) calls.

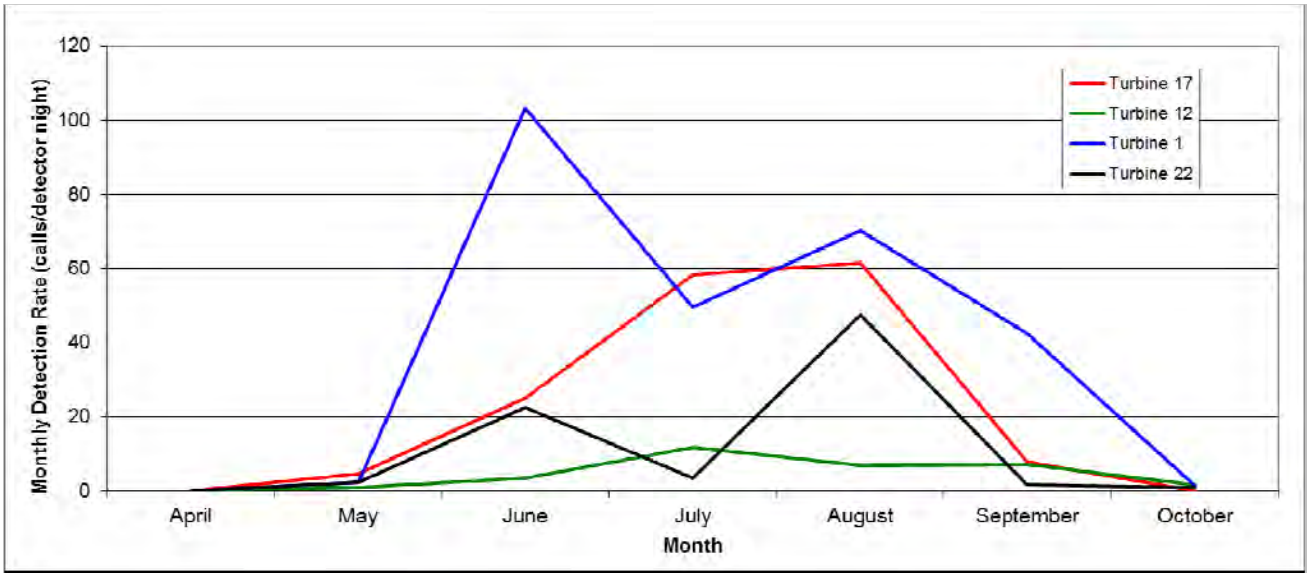

Figure 3-6. Monthly bat detection rates for all detector locations during 2012 at Record Hill.

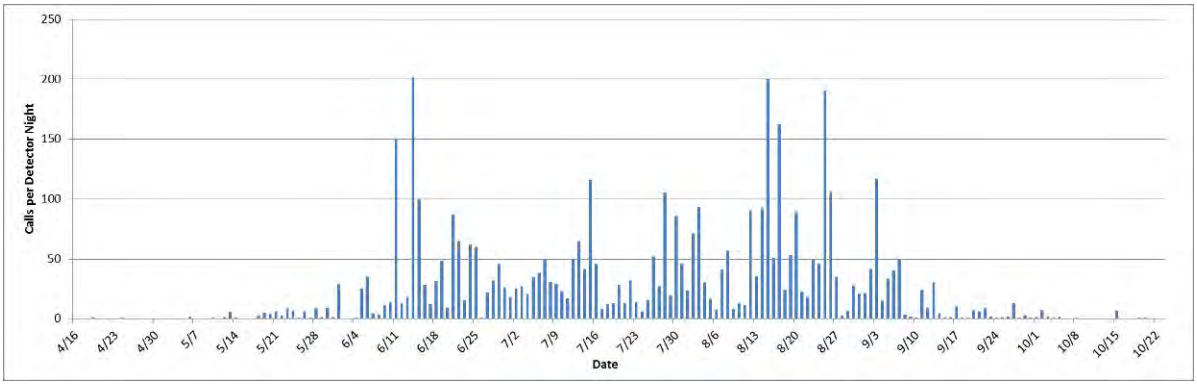

Figure 3-7. The number of call sequences per detector night recorded at all detector locations combined during 2012 at Record Hill.

Overall nightly activity rates were highest during the second four hours after sunset, and hourly activity rates varied between individual detectors. Activity at the Turbine 1 detector was highest during the second hour after sunset, followed by a second smaller peak in the fifth hour, then decreased steadily until sunrise. The Turbine 12 detector recorded the highest level of activity during the first hour after sunset, followed by a smaller pulse in the fifth hour after sunset. Activity peaked during the second hour of activity at the Turbine 17 detector and then decreased until sunrise. The Turbine 22 detector recorded two pulses in activity; the first and largest was

recorded during the second hour after sunset, and the second and smaller pulse occurred during the fourth hour after sunset (Figure 3-8).

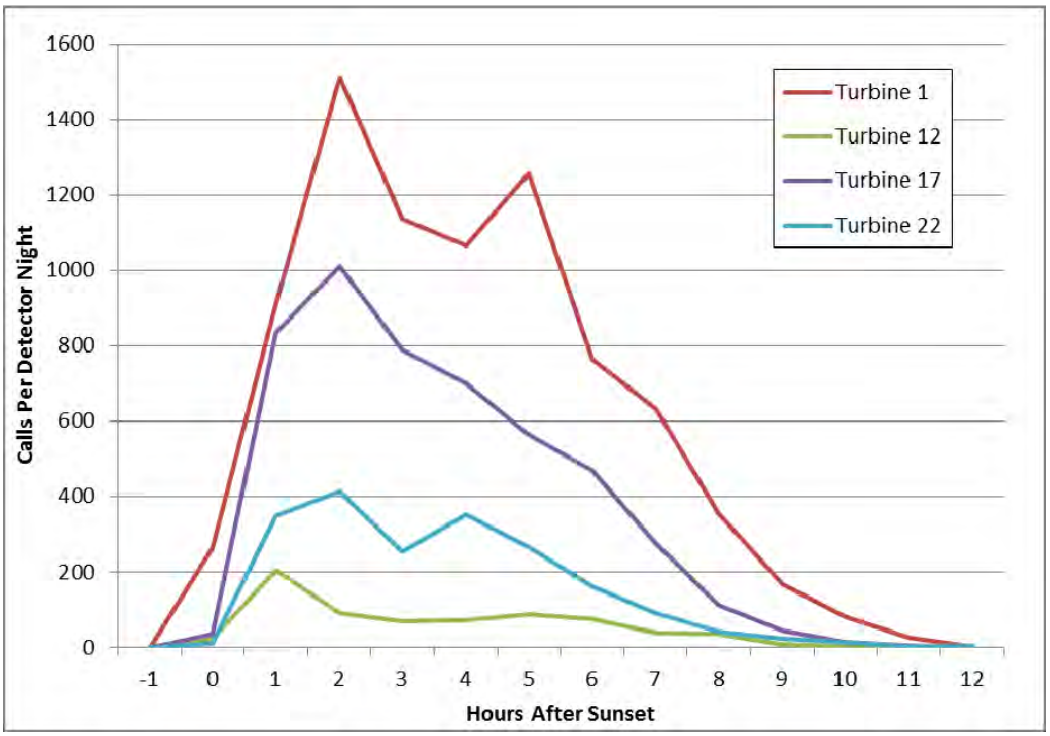

Figure 3-8. The number of call sequences recorded during each hour of the night at all detector locations during 2012 at Record Hill.

3.3.2 Species Composition

Call sequences belonging to all 5 guilds were identified at each of the 4 detector locations during the acoustic survey (Table 3-2). The largest proportion of calls recorded by all detectors was from the BBSH guild (39%, n=6,190), the LFUN guild (24%, n=3,805), and the HB guild (22%, n=3,524) (Table 3-2). More than half of the calls placed in the LFUN guild (53%, n=2,001) appeared to be HB calls, but lacked sufficient detail to meet the criteria for species level identification (i.e. less than five call pulses within the recording). Similarly, 12% (n=443) of calls placed in the LFUN guild appeared to be LANO calls. Within the HFUN guild, 15% (n=216) calls appeared to be LABO calls.

The proportion of calls by species group varied at individual detectors (Figure 3-9). Calls from the BBSH guild represented the largest proportion of calls at each of the four detectors and ranged from 37% at the Turbine 1 detector, to 43% at the Turbine 17 detector. Hoary bat calls represented more than a quarter of all calls recorded at the Turbine 1 (32%, n=2,653), and the Turbine 22 detectors (25%, n=486). Myotis species calls represented 0.4% (n=56) of all calls recorded; the Turbine 1 detector recorded the highest number of Myotis calls (n=39) of any of the four detectors.

Table 3-2. Distribution of detections by guild for detectors at Record Hill, 2012.

Detector	Guild						Total
	BBSH	HB	MYSP	RBTB	HFUN	LFUN	
Turbine 1	3019	2653	39	555	780	1127	8,173
Turbine 12	275	56	3	66	171	141	712
Turbine 17	2101	329	9	93	323	2002	4,857
Turbine 22	795	486	5	32	129	535	1,982
Total	**6,190**	**3,524**	**56**	**746**	**1,403**	**3,805**	**15,724**
Guild Composition %	**39.4%**	**22.4%**	**0.4%**	**4.7%**	**8.9%**	**24.2%**	

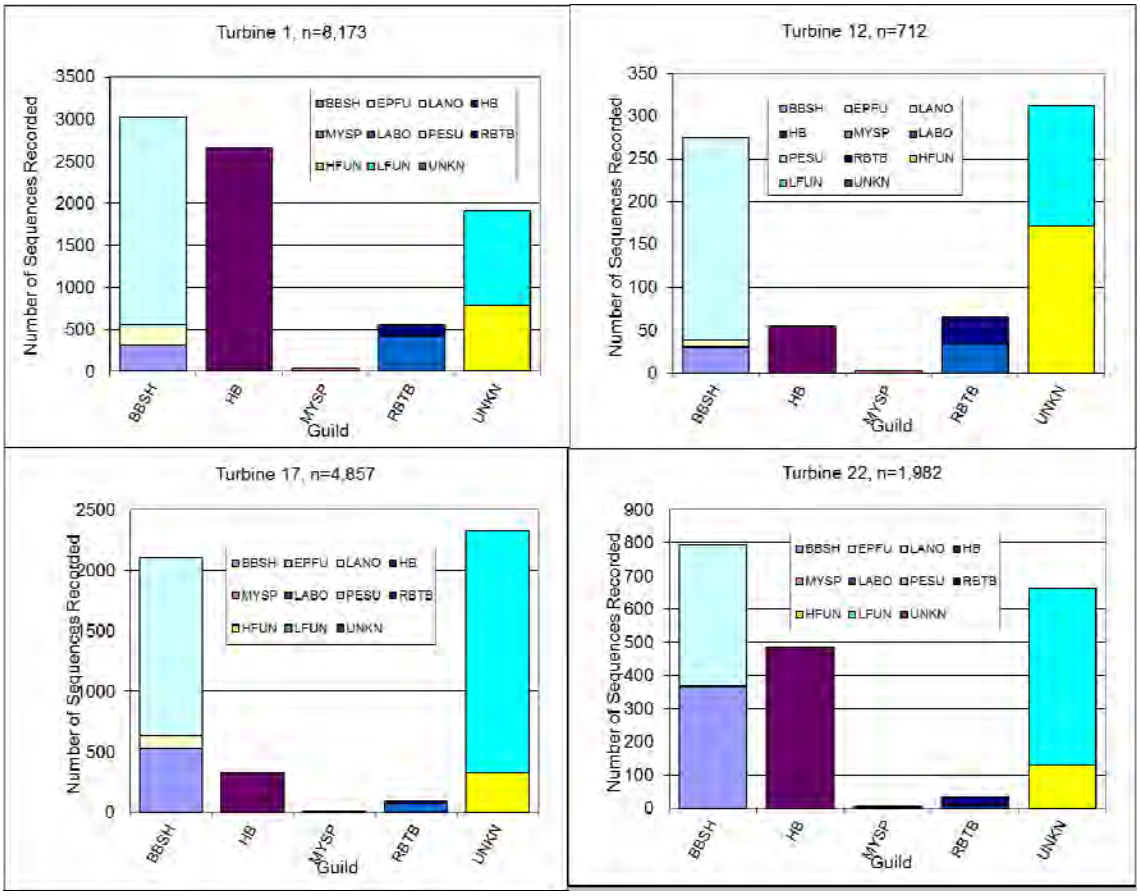

Figure 3-9. Histograms showing species composition of recorded bat call sequences at all detector locations at Record Hill, 2012. BBSH = big brown/silver-haired, HB = hoary bat, MYSP = Myotis species, RBTB = red bat/tri-colored bat, UNKN = unknown, LFUN = low frequency unknown, HFUN = high frequency unknown, PESU = tri-colored bat, LABO = red bat, LANO = silver-haired bat, EPFU = big brown bat.

Tables 1 through 4 in Appendix C provide more specific information on the nightly timing, number, and species composition of recorded bat call sequences. Specifically, Appendix C Tables 1 through 4 provide information on the number of call sequences, by guild and suspected species, recorded at each detector location, and the weather conditions for each night. Analook files for all recorded call sequences can be made available upon request.

3.3.3 Activity and Weather

Mean nightly wind speeds in the Project area during the survey period varied between 2 and 17 m/s, and mean nightly temperatures varied between -4°C (25° Fahrenheit [F]) and 23°C (73°F) (Figure 3-10). From April 16 to October 23, 83% of the detector nights surveyed (n=532) had a mean nightly wind speed of 5 m/s or less, and 49% of detector nights surveyed (n=313) had an mean nightly temperature of 15°C (59°F), or greater. Although activity was highly variable over the course of the survey, the highest levels of bat activity were recorded on nights when mean wind speeds were 5 m/s or less (90%, n=14,135); 73% (n=11,465) of all calls were recorded on nights with a mean nightly temperature of 15°C or higher. The highest nightly activity rate of all detectors combined occurred on June 14, when mean nightly wind speed was 4 m/s and mean nightly temperature was 14°C (57°F).

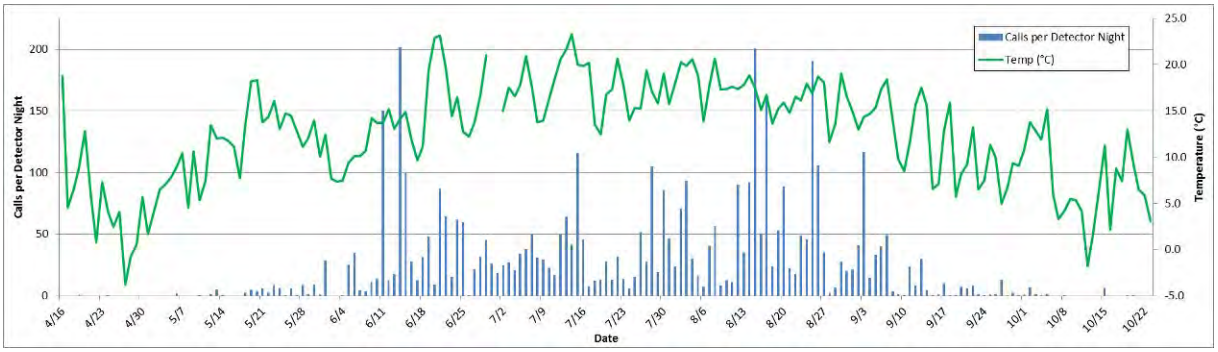

Figure 3-10. Mean nightly temperature and call per detector night recorded at all detectors during 2012 acoustic surveys at Record Hill

3.4 DISCUSSION

Acoustic bat surveys were conducted between April 16 and October 23, 2012, with bat activity documented by at least one or more of the four detectors during 69% of surveyed detector nights. Activity was documented as early as April 19 and as late as October 20, 2012. Only 28 call sequences were recorded during the first 30 calendar nights of acoustic surveys, from mid-April to mid-May, and 142 call sequences were recorded during the final 30 calendar days of survey from late September to late October. Bats were detected most frequently during the summer months of June (39 call sequences/detector night) and August (55 call sequences per detector night). Individual detection rates at the different detectors varied from month to month and between detectors. For the entire survey period, individual detection rates ranged from 5.4 call sequences recorded per detector-night at the Turbine 12 detector to 49.5 call sequences recorded per detector-night at the Turbine 1 detector. Each of the four detectors was deployed in similar habitats, and each was located at the edge of the turbine pad clearings, approximately 40 m from the base of their respective turbines. The Turbine 1 detector, with the highest activity, was located at the northern extent of the Project. The Turbine 12 detector, with the lowest activity, was located centrally within the Project area, at the highest elevation. Bat calls were identified to guild, although calls were provisionally identified to species when possible

during analysis. Certain species such as the eastern red and hoary bat have easily identifiable calls, whereas other species, such as the big brown bat and silver-haired bat, are often difficult to distinguish acoustically. Similarly, acoustic call profiles of species within the *Myotis* genus share common characteristics and no attempt was made to differentiate call sequences within this genus.

Of those calls that could be identified to species or guild, calls from the BBSH guild contained the highest number of call sequences recorded (39%; n =6,190). Of the calls placed in the BBSH guild, 74% were identified as silver-haired bat calls (n=4,585), 6% were identified as big brown bat calls (n=362), and 20% lacked sufficient detail to make the distinction between silver-haired and big brown bat calls (n=1,243). On June 14, the night with the highest level of activity, hoary bats comprised 80% (n= 640) of the total 805 calls recorded that night.

Throughout the entire survey period less than 1% (n=56) of calls were identified as *Myotis* species. During the fall of 2007 and spring of 2008, pre-construction acoustic surveys were conducted at the Project area using identical acoustic sampling and analysis methodology, and similar detector placement. During pre-construction survey periods, *Myotis* species represented 66% of calls in the fall survey period, and 45% of all calls recorded during spring 2008. *Myotis* species have been particularly affected by white-nose syndrome which has become widespread in the Northeast (Brooks 2010, Watrous et al. in prep). In 2011, White Nose Syndrome (WNS) was documented at two locations in Oxford County, Maine. Analysis of a large scale acoustic dataset collected over eight years, at multiple survey sites across the eastern U.S. indicates that acoustic recordings from detectors deployed below tree canopy height (<10 m) were dominated by Myotis species calls during pre-WNS conditions; however Myotis species typically represented a small proportion of all calls recorded at locations four years post-WNS detection (Stantec, unpublished data). Although this survey was conducted only one year post-WNS detection, the decline in the proportion of Myotis species at the Project area is likely attributed to affects from WNS.

At the Project, the highest levels of bat activity were recorded on nights when mean wind speeds were 5 m/s or less (90%, n=14,135). Although some activity at the Project did occur on cold nights, peak activity occurred on nights with temperatures above 15°C (59°F) (73%; n=11,465). Activity levels were highest during the warmer months from June to August. These warmer months correspond with the timing of both increased foraging activity, and bat offspring (pups) becoming volant. However, the night with the highest activity was June 14 (805 total calls) when mean nightly wind speed was 4 m/s and mean nightly temperature was 14°C (57°F). Though the majority of calls recorded at the Project occurred on nights with temperatures of 15°C (59°F) or above, the increased activity levels that occurred on June 14 may be influenced by the low nightly wind speed of 4 m/s.

Pre- and post-construction acoustic monitoring surveys at many proposed wind facilities have documented a negative relationship between bat activity levels and average nightly wind speed (Fiedler 2004, Reynolds 2006). Reynolds (2006) found activity of bats to be highest on nights with wind speeds of less than 5.4 m/s during the fall migratory period at the Maple Ridge, New

York wind facility. Bat activity levels at Buffalo Mountain, Tennessee also showed a negative association with average nightly wind speeds (Fiedler 2004). Pre- and post-construction acoustic monitoring surveys have also documented bat activity to be positively correlated with nightly mean temperatures (Fiedler 2004, Reynolds 2006). Reynolds (2006) found that no detectable fall migratory activity occurred on nights when the mean temperature was below 10.5°C (50.9°F). Bat activity at Buffalo Mountain, Tennessee from 2000 to 2003 was most closely correlated with average nightly temperature (Fiedler 2004).

All 4 detectors were deployed in the vicinity of turbines that were searched during the 2012 fatality study. A total of 44 bat carcasses were found at the Project during the fatality searches, 9 of these bats were found at 3 of the turbine locations where detectors were deployed. Six bats were found at Turbine 1, 2 bats were found at Turbine 12, and 1 bat was found at Turbine 22. It is notable that the location with the highest number of bat calls recorded (Turbine 1 detector) was also the location with the largest number of bat fatalities found at any one turbine. Bat fatalities found at Record Hill during turbine searches included the tree-roosting bat species, eastern red bat, hoary bat, and silver-haired bats. The majority of bat fatalities found (48%, n=21) were eastern red bats; however eastern red bat calls only represented 5% of all calls recorded at all detectors. This percentage includes HFUN calls that were either less than 5 pulses or of poor quality but were believed to be eastern red bat calls. Hoary bats represented 23% (n=10) of bat fatalities found during searches. Including the LFUN calls believed to be hoary bat calls; hoary bats represented only 35% of calls recorded at all detectors. Silver-haired bats represented 30% (n=13) of all bat carcasses found during the 2012 fatality study, and represented 32% of acoustic recordings, including those LFUN calls thought to be silver-haired bat calls. The species found most commonly during fatality searches (tree-roosting species) also represented the species most commonly recorded by the acoustic detectors: all tree-roosting bat calls combined constituted 72 percent of recorded bat calls in 2012. The timing of the species specific fatality events generally coincided with the timing of species specific bat call recordings at Record Hill in 2012 (Figure 3-11). However, it should be noted that there was a break in fatality searches from June 8 to July 6 and the greatest number of bat calls were recorded on June 14. Of the three migratory tree species, the first recording of red bats was detected later in the season than the other 2 species, with the first red bat call recorded on June 29. The last red bat fatality recovered during the 2012 searches was found on August 14; however, acoustic detectors recorded red bat activity as late as October 20. Hoary bat fatalities also coincided with the hoary bat active period observed in acoustic recordings. However, no hoary bat fatalities were documented from June 1 to July 23, a period in which acoustic detection rates were highest for hoary bats. The first silver-haired bat fatality was discovered on April 17, but silver-haired bats were not identified in acoustic recordings until 26 days later on May 13. The remaining 12 silver-haired bat fatalities were found from July 24 September 8, which generally corresponded with a decline in the magnitude of silver-haired bats recorded by detectors (Figure 3-11).

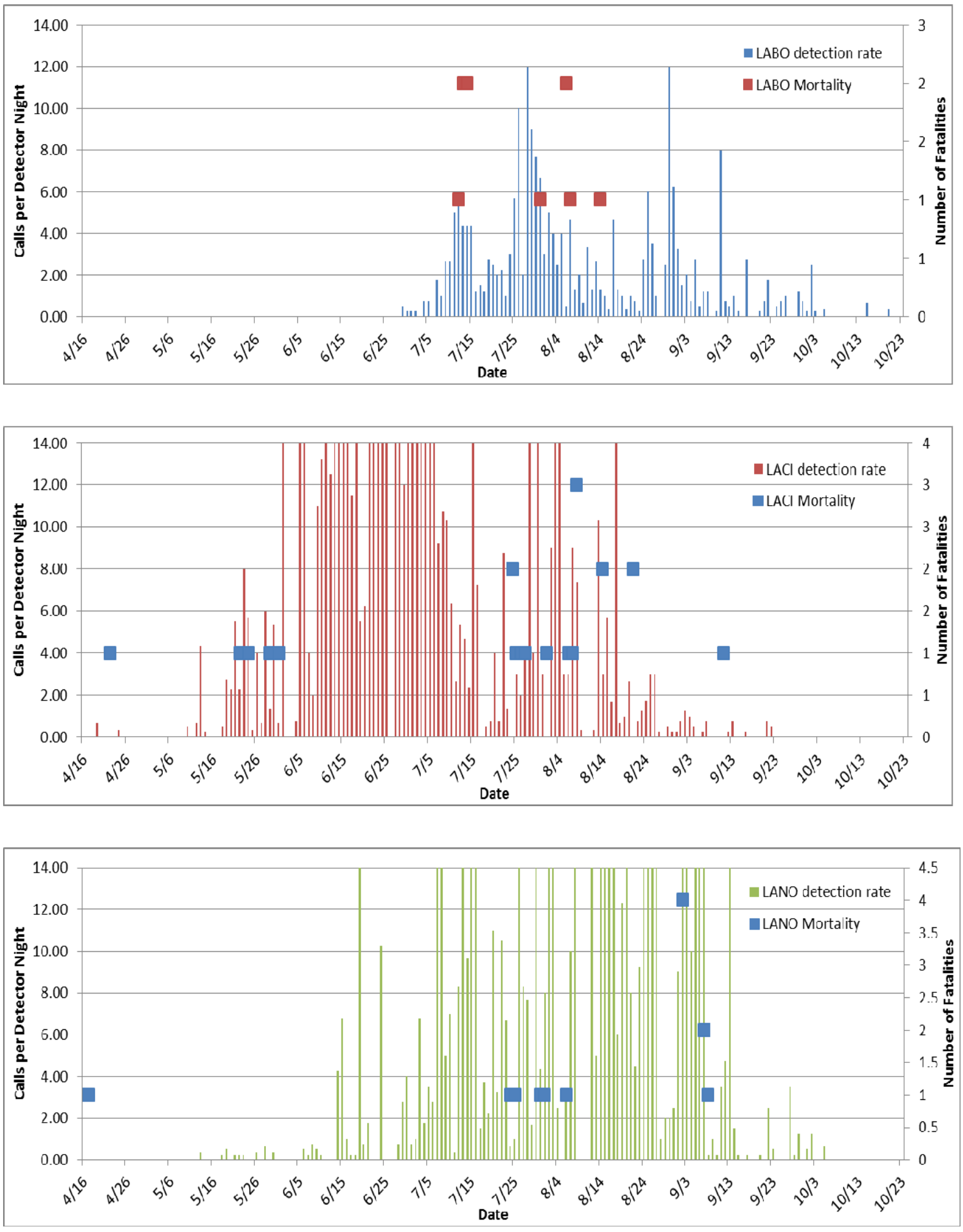

Figure 3-11. Timing of tree-roosting bat calls per detector night for all detectors combined, and timing of bat fatalities at Record Hill 2012 (Note: fatality searches were not conducted from June 8 to July 6).

Data presented in this report are representative of trends often observed during acoustic surveys conducted at projects in the U.S.; these trends include variable overall activity throughout the survey period and noticeable peaks in bat activity corresponding with season and weather (Fiedler 2004, Reynolds 2006, Kunz et al. 2007, Arnett et al. 2008, Baerwald and Barclay 2009).

4.0 Eagle and Raptor Migration Surveys

4.1 INTRODUCTION

Consistent with the *Post-construction Monitoring Plan* and the *Eagle Risk Minimization Plan* (February 2012) for the Project, Stantec conducted diurnal raptor migration surveys to document eagle and raptor activity in the airspace over the Project during spring and fall 2012. Surveys were designed to document the number of individuals and species observed, as well as raptor locations and behaviors in relation to the operational turbines. Although the migratory surveys documented all raptor species observed, the principal species of interest was bald eagle. The Work Plan had also included a summer eagle use survey if the eagle nest on French Island in Roxbury Pond was active in 2012. The nest was determined to be inactive during the spring 2012 surveys and therefore, MDIFW indicated via email on August 2, 2012 that the summer eagle surveys were not required.

Ten days of raptor migration surveys occurred in spring (mid-March to late May) and 13 survey days occurred in fall (late August to mid-November). Note that protocol for eagle and raptor migration surveys detailed in the Project's *Post-construction Monitoring Plan* and *Eagle Risk Minimization Plan* specify 10 fall survey days. Stantec added three additional fall surveys in late October into November to extend sampling to capture the known fall migration period for bald eagles.

4.2 DATA COLLECTION METHODS

4.2.1 Field Surveys

4.2.1.1 Observation Locations

Surveys generally were conducted from Turbine 12,[6] which allowed for visibility of raptor movements in the vicinity of nearly every Project turbine (Figure 1-1; Photos 1-4). From Turbine 12, during maximum visibility days, Mount Washington and the western half of Roxbury Pond could be seen to the west and the Granite Reliable Wind Project in Coos County, New Hampshire, could partially be seen to the northwest. The Height of Land near Rangeley, Maine

[6] Three survey days in spring were conducted from Turbine 11 due to maintenance at Turbine 12.

could be seen to the north. Tumbledown and Little Jackson mountains near Farmington could be seen to the east. White Cap and Black Mountains near Rumford could be seen to the south (Photos 1-4).

Photos 1-4. View to north (top left), east (top right), south (bottom left), and west (bottom right) from raptor observation location at Turbine 12.

Seven one-hour surveys occurred from the Project access gate ('Gate'), which offered a view of French Island on Roxbury Pond (Figure 1-1; Photo 5). The purpose of these surveys was to investigate if the bald eagle nest on French Island was active in 2012.

Photo 5. View of Roxbury Pond, west of Project Gate

4.2.1.2 Methods

Surveys targeted days with optimal migration conditions, including days following the passage of weather fronts bringing high atmospheric pressure and days with moderate to light wind speeds. Raptor migration is facilitated by tail winds (winds aligned with the preferred direction of travel), which "push" migrating raptors forward (Bildstien 2006); however, some raptors will fly in light or moderate headwinds. Days with tail winds and headwinds were sampled.

Surveys were generally conducted from 9 am to 4 pm, during the peak hours of thermal development and raptor movement. During surveys, observers scanned the sky and surrounding landscape for raptors by eye and with binoculars. Observers recorded hourly weather observations, including wind speed and direction, temperature, and sky conditions. Detailed information for each observation was recorded on datasheets and project area maps, including:

- observation date and time;
- species, number of individuals, and age (if possible);
- if the raptor occurred within the turbine areas ('Project area,' as depicted in Figure 1-1);
- flight positions of each bird in relation to topography of the area;
- flight height (above ground) of each bird (within each different topographical flight position);

- specific flight behaviors of each bird;
- general flight direction of each bird;
- if the bird was actively migrating;
- number of the closest turbine and distance between raptor and the closest turbine;
- whether the raptor's flight path was between or above the turbines;
- if the closest turbine was spinning; and
- other notes describing the general activity of each bird, in particular any observations of raptor-turbine interactions.

Topographical flight positions were summarized into categories that describe the landscape surrounding the observation site (these positions apply to birds observed both within as well as outside of the Project area): A1) parallel to ridge, A2) perpendicular to ridge, A3) over saddle, B) flight path over upper slope of ridge, C) flight path over lower slope of ridge, and D) flight path over a valley (see Figure 4-1 below). As individual birds traveled through or in the vicinity of the Project, all position categories in which a bird occurred were recorded.

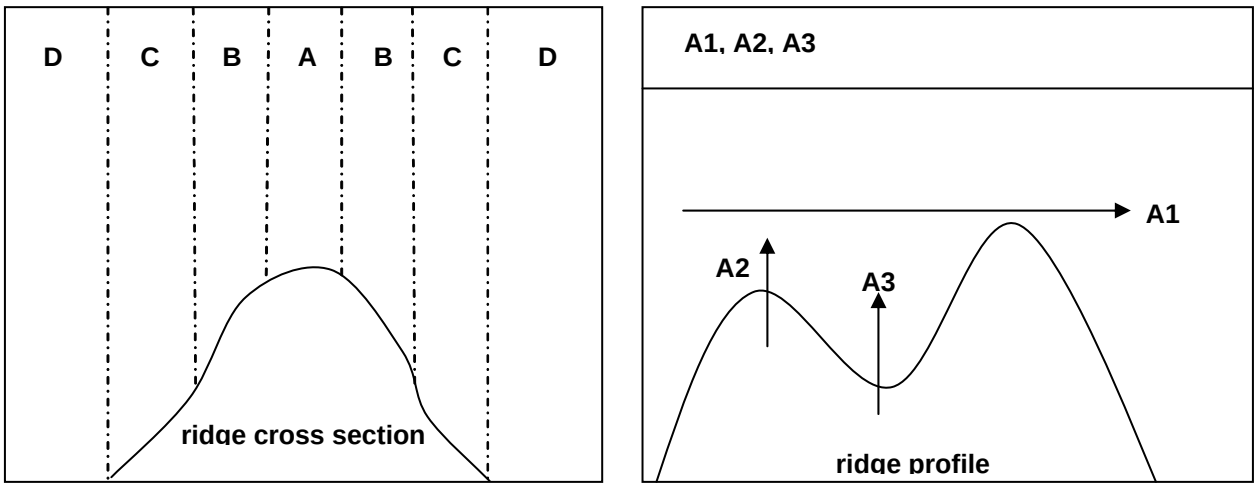

Figure 4-1. Raptor flight position categories in relation to the topography of the Project area and surrounding area.

The flight height of birds in each of the flight position categories they occurred in was recorded. Nearby objects with known heights, such as the turbines and tree canopy, were used to gauge flight height.

Flight behaviors where categorized as: circle soaring, linear soaring (straight-line soaring or slow gliding in a 'thermal street' formed between updrafts), gliding (with wings partially closed and bent wrists), powered flight (flapping wings), banking (breaking with fully extended wings and tail fanned), diving (wings partially to mostly closed while in descent), kiting (using wind

current to kite with partially closed wings and tail), hovering (maintaining a stationary altitude with some flapping and fanned tail while hunting and looking downward), aerial feeding (eating prey in flight while in a soar or slow glide), aerial hunting low over the ground, aerial display (territorial or courtship aerial display), or perched. These behaviors among others were used to describe birds as actively migrating or not-actively migrating.

Birds that flew too rapidly or were too far to accurately identify were recorded as unidentified to their genus or, if the identification of genus was not possible, unidentified hawk. Observers collected incidental data for other avian species observed including passerines and water birds.

4.3 DATA ANALYSIS METHODS

Raptor observation data were summarized by survey day and for the entire survey period for the spring and fall periods. Analysis included a summary of:

- total number of individuals per species observed each survey day, and for the entire survey period;
- daily passage rates (birds per hour) calculated for each survey day, as well as for the entire survey period;
- percentage of birds within each topographical flight position category;
- average minimum flight height of birds within each topographical flight position category;
- percentage of all birds that occurred within turbine areas (‘Project area’);
- for all birds observed within turbine areas, flight heights were categorized as less than or greater than 126.5 m (415 ft) above ground;
- percentage of birds believed to be actively migrating;
- flight behaviors of all birds observed; and
- a summary of any avoidance behaviors (such as banking or adjusting flight path or behavior while in close proximity to turbines).

4.4 RESULTS

4.4.1 Survey Effort and Weather

In spring, 7 surveys were conducted at Turbine 12; 3 survey days were conducted at Turbine 11 due to turbine maintenance at Turbine 12. Seven hours were sampled from the Gate during survey days. Data from surveys at all 3 locations were combined for ease of summarization.

Stantec conducted surveys on 10 days in spring and 13 days in fall resulting in 158.5 total survey hours (69.5 in spring, 89 in fall). Spring surveys were conducted from March 20 to May 18 and fall surveys were conducted from September 6 to November 6. Including those birds

seen within and outside the Project area (turbine areas), a total of 142 raptors representing 10 species[7] were observed (5 in spring and 10 in fall). Thirty-six raptor observations were documented in spring and 106 raptor observations were recorded in fall. The passage rate for the spring season was 0.5 and for the fall season was 1.2 observations/hour.

Table 4-1. Summary of the spring and fall 2012 eagle and raptor survey effort and results at the Record Hill Wind Project

	Spring	**Fall**
Range of survey dates	3/20-5/18	9/6-11/6
No. survey days	10	13
No. survey hours	69.5	89
No. raptor species observed	5	10
Raptor species observed		
American kestrel (*Falco sparverius*)		Y
bald eagle (*Haliaeetus leucocephalus*)	Y	Y
broad-winged hawk (*Buteo platypterus*)	Y	Y
Cooper's hawk (*Accipiter cooperii*)		Y
merlin (*Falco columbarius*)		Y
osprey (*Pandion haliaetus*)		Y
red-shouldered hawk (*Buteo lineatus*)	Y	Y
red-tailed hawk (*Buteo jamaicensis*)		Y
sharp-shinned hawk (*Accipiter striatus*)	Y	Y
turkey vulture (*Cathartes aura*)	Y	Y
unidentified accipiter hawk		Y
unidentified buteo hawk	Y	Y
unidentified eagle		Y
unidentified falcon		Y
unidentified hawk		Y
Total no. observations of raptors	36	106
Total no. observations of bald eagles	2	3
Seasonal passage rate (raptor observations/hour)	0.5	1.2
Bald eagle passage rate	0.03	0.03
Total no. observations of raptors within Project area (percent of total observations)	13 (36%)	65 (61%)
Total no. of observations of raptors seen in the Project area and below max turbine height (percent of observations within project area) ; (percent of total observations)	10 (77%) ; (28%)	43 (66%) ; (41%)

In spring, winds were variable over the course of the surveys, but predominately westerly. Wind speeds generally ranged from calm to 19-24 mph (8-11 m/s). Wind speeds were 9-12 mph (4-5 m/s) or less on 7 out of the 10 survey days (70%). Sky conditions were clear to partly cloudy in spring except for on 2 days, May 3 and May 8 when fog or drizzling rain reduced visibility for (Table 4-2).

[7] Species detected include unidentified buteo and unidentified hawk. Further, although turkey vultures are not phylogenetically considered true raptors, they are diurnal migrants that exhibit flight characteristics similar to *Buteos, Accipiters* and other *Falconiformes* species, therefore vultures are typically included as raptor species during hawk watch surveys.

In fall, winds also were variable, and predominantly westerly. Wind speeds ranged from calm to 13-18 mph (6-8 m/s). Wind speeds were 4-7 mph (2-3 m/s) on 10 out of the 13 survey days (77%). Sky conditions generally were clear to partly cloudy except for on 2 days, September 24 when sporadic showers reduced visibility during 2 survey hours, and on October 10 when the presence of fog ended the survey after 5.5 hours (Table 4-3).

Table 4-2. Wind direction and pressure systems during spring 2012 surveys at the Record Hill Wind Project.

Date	Wind direction	Wind speed code (s)	Daytime Pressure System (high or low)
3/20/2012	W	4	High pressure from NW moving through.
3/21/2012	NW	3	Stalled high pressure across region.
3/27/2012	NW	5	High pressure; approaching low from NW.
4/19/2012	SW	2	Passing low; 2nd low approaching from W.
4/26/2012	SW	3	Passing low; 2nd low approaching from W.
5/3/2012	SW	1	Extensive low pressure system from SW covers region; precipitation.
5/7/2012	W	0	High pressure; approaching low from SW.
5/8/2012	SW	1, 2	Low pressure; precipitation.
5/17/2012	NW	3, 4	Brief high follows a low pressure system with precipitation; approaching low from NW.
5/18/2012	SW	1, 2	Stalled high pressure behind a passing cold front.

Wind Speed codes 1 = 1-3 mph; **2** = 4-7 mph; **3** = 9-12 mph; **4** = 13-18 mph; **5** = 19-24 mph

Table 4-3. Wind direction and pressure systems during fall 2012 surveys at the Record Hill Wind Project.

Date	Wind direction	Wind speed code (s)	Daytime Pressure System (high or low)
9/6/2012	WSW	0, 1, 2	High pressure approaching from southwest.
9/7/2012	WNW	1, 2, 3	Low pressure passing.
9/11/2012	NW	2, 3	None
9/12/2012	W, SW	2	None
9/20/2012	E, SE, S	1	High pressure passing.
9/24/2012	NW, SW	0, 1, 2	High pressure stalled over region.
9/25/2012	SW	1	None
10/5/2012	W	2	Low pressure passing, high pressure approaching.
10/9/2012	SE	1, 2	High pressure passing.
10/10/2012	variable	0, 1, 2	High pressure passing.
10/24/2012	W, NW	1, 2, 3	High pressure passing, low pressure approaching.
10/25/2012	S	0, 1, 2	High pressure passing.
11/6/2012	NW, W	3, 4	None

Wind Speed codes 1 = 1-3 mph; **2** = 4-7 mph; **3** = 9-12 mph; **4** = 13-18 mph; **5** = 19-24 mph

4.4.2 Passage Rates and Species Composition

In spring, the day with the highest passage rate (2.00 raptors/hour) occurred on May 7 when 13 raptor observations were recorded (Figure 4-2; Appendix D Table 1). The majority of

observations on this day were turkey vulture (*Cathartes aura*) observations (69%; n=9). This day was clear with winds less than 1 mph (0.4 m/s) from the west.

In fall, the day with the highest passage rate (4.15 raptors/hour) occurred on September 6 when 28 raptor observations were recorded (Figure 4-3; Appendix D Table 2). The majority of observations on this day were migrant broad-winged hawk (*Buteo platypterus*) observations (39%; n=11). This day was partly cloudy day with light west-south-west winds.

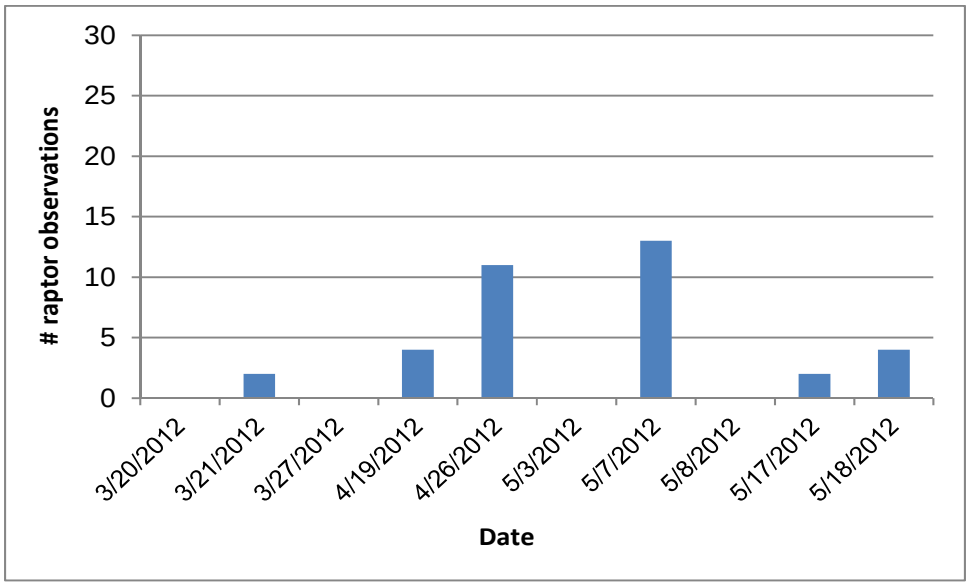

Figure 4-2. Number of individuals per survey day observed at Record Hill, Spring 2012

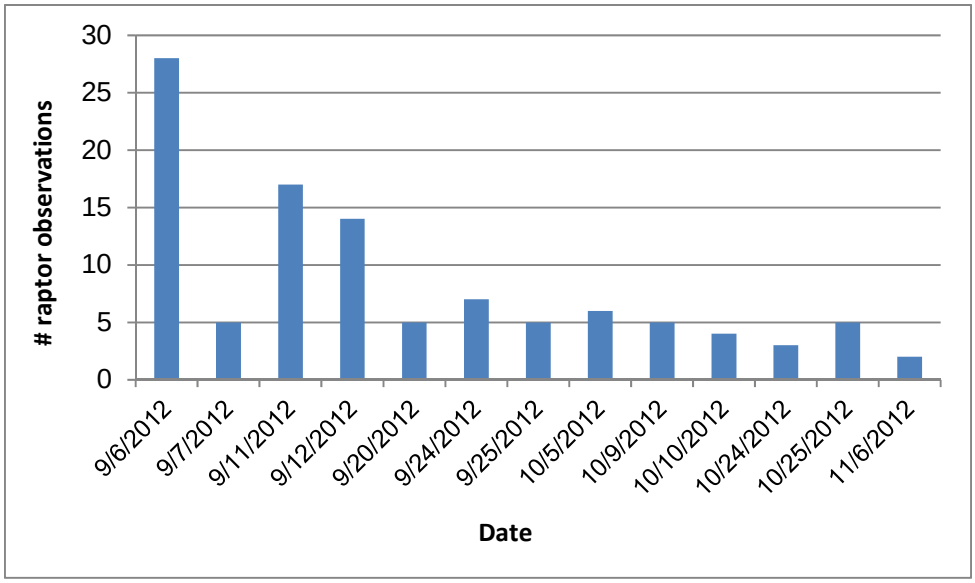

Figure 4-3. Number of individuals per survey day observed at Record Hill, Fall 2012

Among all survey days in spring, turkey vulture (n=26; 72%) was the most frequently observed species (Figure 4-4; Appendix D Table 1). Two observations of adult bald eagles occurred on March 21.

In fall, turkey vulture (n=36; 34%) also was the most frequently observed species (Figure 4-5; Appendix D Table 2). In fall, 3 observations of bald eagles were recorded, one each on September 6, September 24 and September 25. One observation was an adult, 1 was a sub-adult, and 1 was a non-juvenile, meaning the observer could not determine whether or not the individual was an adult or sub-adult due to the observation's distance from the observer and lighting.

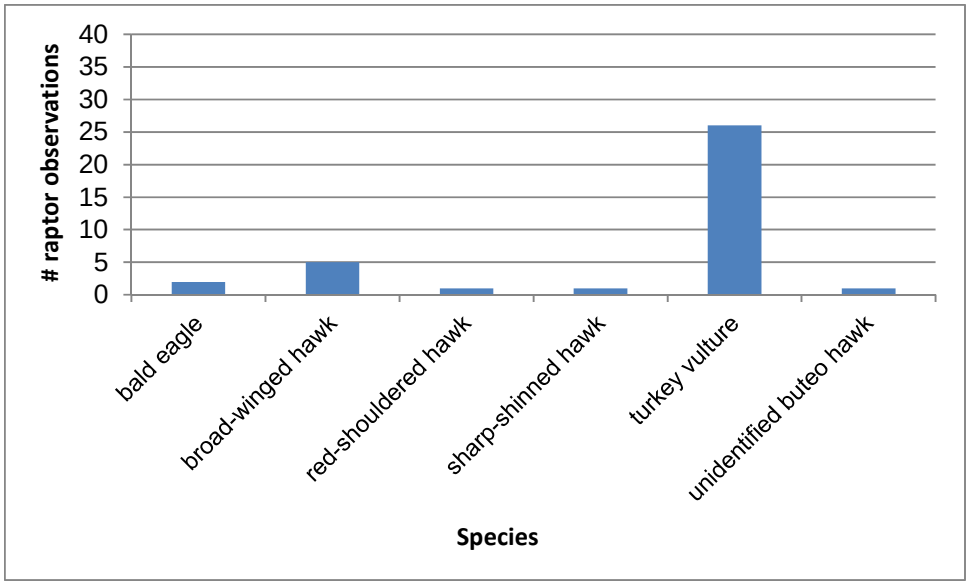

Figure 4-4. Number of individuals per species observed at Record Hill, Spring 2012

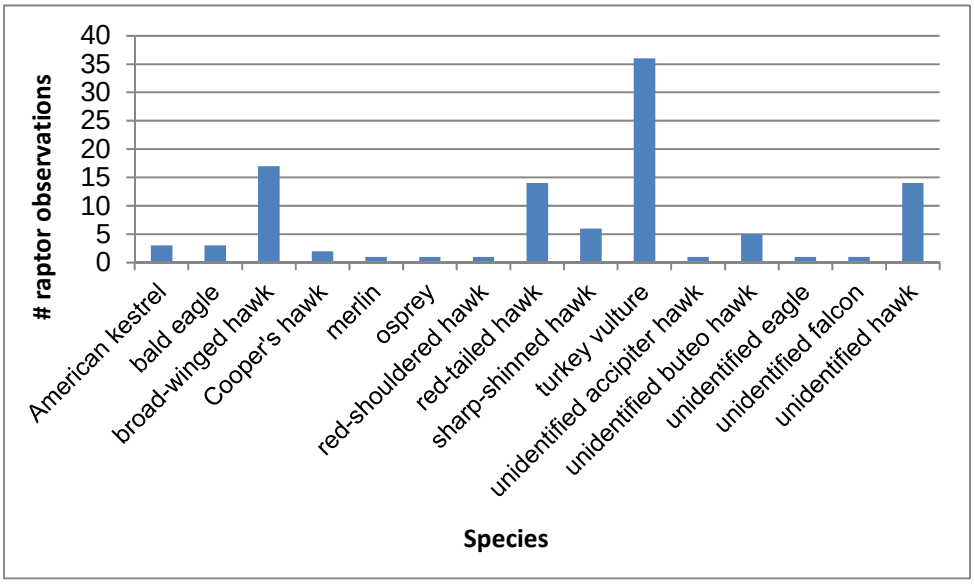

Figure 4-5. Number of individuals per species observed at Record Hill, Fall 2012

In spring on a daily basis, the majority of observations (36%; n=13) occurred between 3:00 pm and 4:00 pm (Figure 4-6; Appendix D Table 3). In fall, the majority of observations (28%; n=30) occurred between 11:00 am and 12:00 pm (Figure 4-7; Appendix D Table 4).

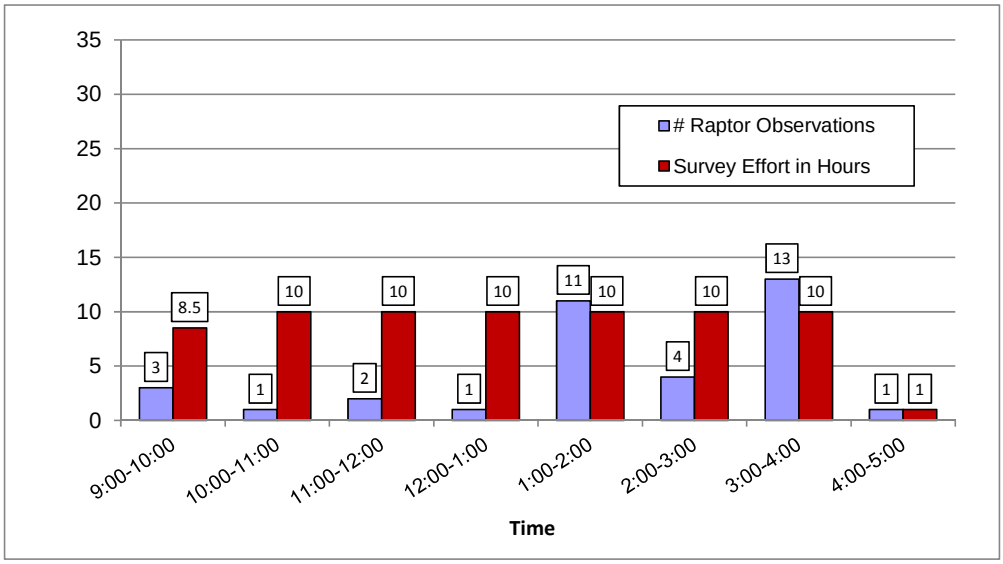

Figure 4-6. Number of individuals observed and number of hours surveyed per survey hour at Record Hill, Spring 2012

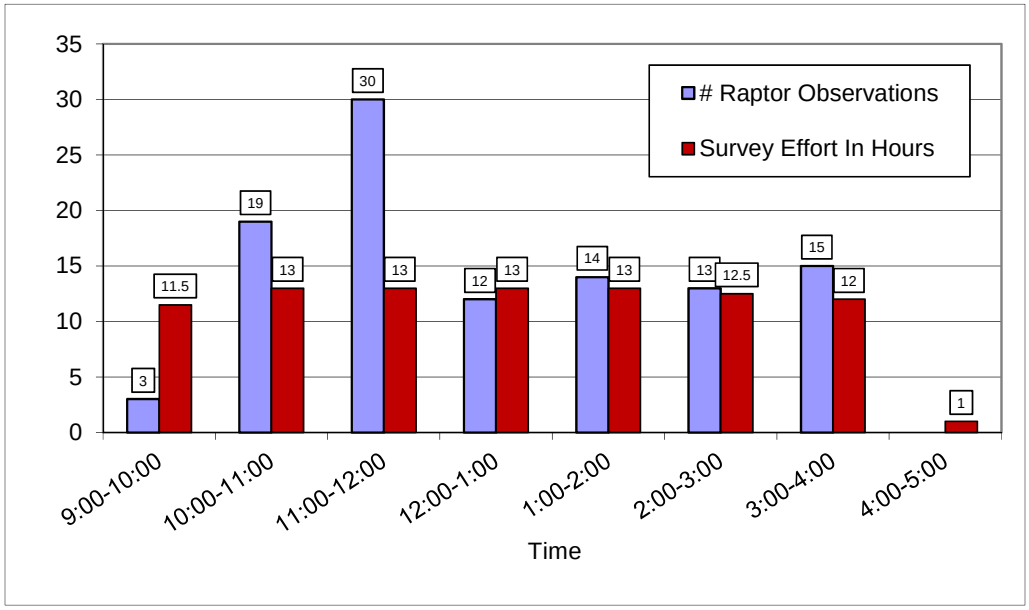

Figure 4-7. Number of individuals observed and number of hours surveyed per survey hour at Record Hill, Fall 2012

4.4.3 Flight Location and Height

In spring and fall, the greatest proportion of observations' positions were over the upper slope of the ridge (52%; n=22 in spring; 30%; n=49 in fall). As individual birds occurred in multiple positions as they traveled in the vicinity of the Project, there are more flight positions than individuals observed. In spring, average minimum flight height of ridge crossing observations was 103 m (338 ft) for crossings at high points and 78 m (256 ft) for crossings at low points (Table 4-4). In fall, average minimum flight height of ridge crossing observations was 122 m (400 ft) for crossings at high points and 88 m (289 ft) for crossings at low points (Table 4-5).

Five bald eagle observations occurred during the 2012 surveys. Two adult eagles were observed over Roxbury Pond and Record Hill in spring and 3 eagles, 1 adult, 1 sub-adult, and 1 non-juvenile, occurred near Turbine 12 and Turbine 1 in fall. In addition, an adult eagle was incidentally observed flying over the Pond on May 6. However, no eagles were observed on French Island during the 2012 surveys, including the Gate surveys, and the French Island nest site was determined to be inactive in 2012.

The 2 bald eagle observations in spring occurred over the saddle (A3) between a hill outside the Project area (Record Hill) and the valley (Roxbury Pond), and the 3 bald eagle observations in fall occurred in each position code. In fall, 3 eagle observations occurred near Turbines 12 (n=1) and 1 (n=2). Two of the 3 observations crossed the turbine string above turbine height (as opposed to between turbines) near Turbine 12 (a sub-adult eagle) and Turbine 1 (an adult eagle); the third observation occurred near Turbine 1 at heights between 150 m (492 ft) and 200 m (656 ft), but did not cross the ridge. One of the 2 observations that crossed the turbine string crossed at a high point along the ridge (A2) at approximately 600 m (1,969 ft) in height. The second observation crossed over A3 at heights between 200 and 250 m (820 ft).

Table 4-4. Number of observations and average flight heights for each position category for birds observed at the Record Hill Wind Project, Spring 2012.

	A1) flight along or parallel to ridge	A2) crossed ridge	A3) flight crossed depression or saddle	B) upper slope	C) lower slope	D) over valley
No. of position observations (will be greater than no. individuals)	1	8	5	22	5	1
Average minimum flight height (m)	75	103	78	85	220	500

Table 4-5. Number of observations and average flight heights for each position category for birds observed at the Record Hill Wind Project, Fall 2012

	A1) flight along or parallel to ridge	A2) crossed ridge	A3) flight crossed depression or saddle	B) upper slope	C) lower slope	D) over valley
No. of position observations (will be greater than no. individuals)	22	31	10	49	33	19
Average minimum flight height (m)	152	122	88	157	214	245

Of the 142 raptors observed in spring and fall, 55% (n=78) were observed within the Project area; 13 raptor observations (36%) occurred in the Project area in spring (Appendix D Table 5), and 65 observations (61%) occurred in the Project area in fall (Appendix D Table 6).

Flight heights were categorized as above or below 126.5 m (415 ft) for raptors observed within Project area. Ten observations (77% of those within the Project area; 28% of total observations) flew lower than 126.5 m for at least a portion of their flight through the Project area in spring (Figure 4-8), and 43 observations (66% of those within the Project area; 41% of total observations) flew lower than 126.5 m through the Project area in fall (Figure 4-9).

In spring and fall, the species with the most observations below turbine height was turkey vulture (n=6; 60% in spring; n=13; 30% in fall). In spring, observations spent a total of 1 minute and 10 seconds (0.03% of total survey seconds) above the Project area, and 1 minute and 8 seconds (.03% of total survey seconds) below turbine height. In fall, observations spent a total of 43 minutes and 38 seconds (0.8% of total survey seconds) above the Project area, and 25 minutes and 32 seconds (0.5% of total survey seconds) below turbine height.

In spring, no bald eagle observations occurred in the Project area. In fall, each of the 3 bald eagle observations (100%) occurred in the Project area. Of the 3 observations, 1 (33%) occurred in the turbine area and below turbine height for a portion of its flight; the minimum flight height of this observation was 100 m and the maximum flight height was 600 m (1,969 ft). This observation flew at a height of approximately 600 m while crossing over Turbine 12. The 3 bald eagle observations in fall spent a total of 3 minutes and 15 seconds in the Project area (0.07% of total fall survey seconds) and 0 minutes below turbine height while crossing the turbine string.

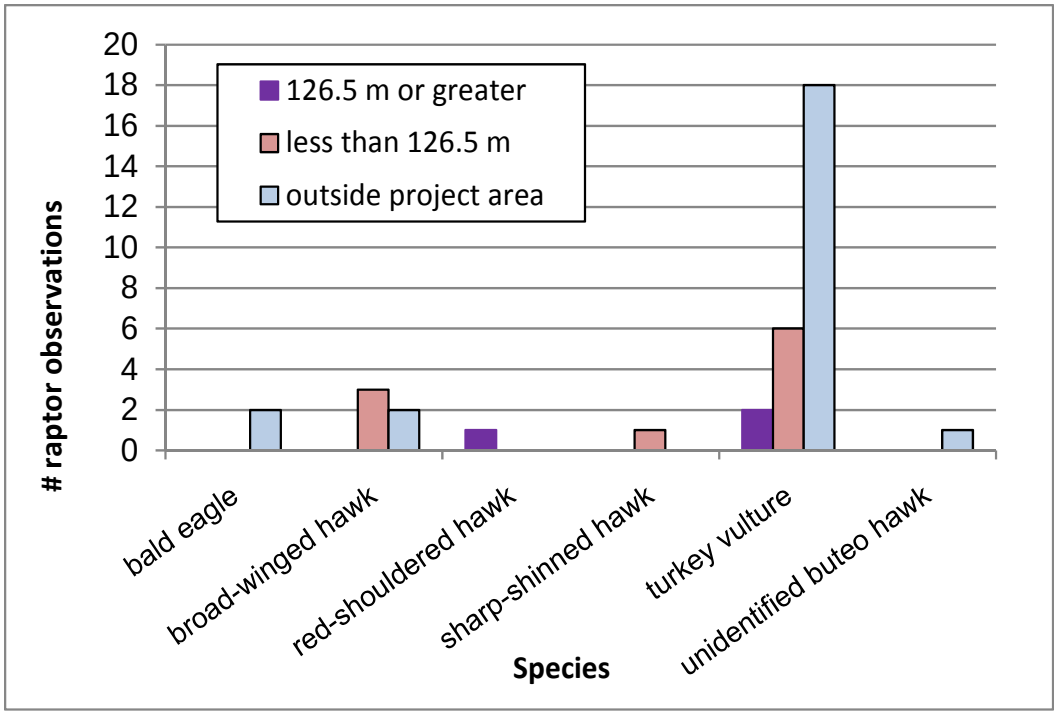

Figure 4-8. Number of individuals observed at heights above or below 126.5 m at Record Hill, Spring 2012

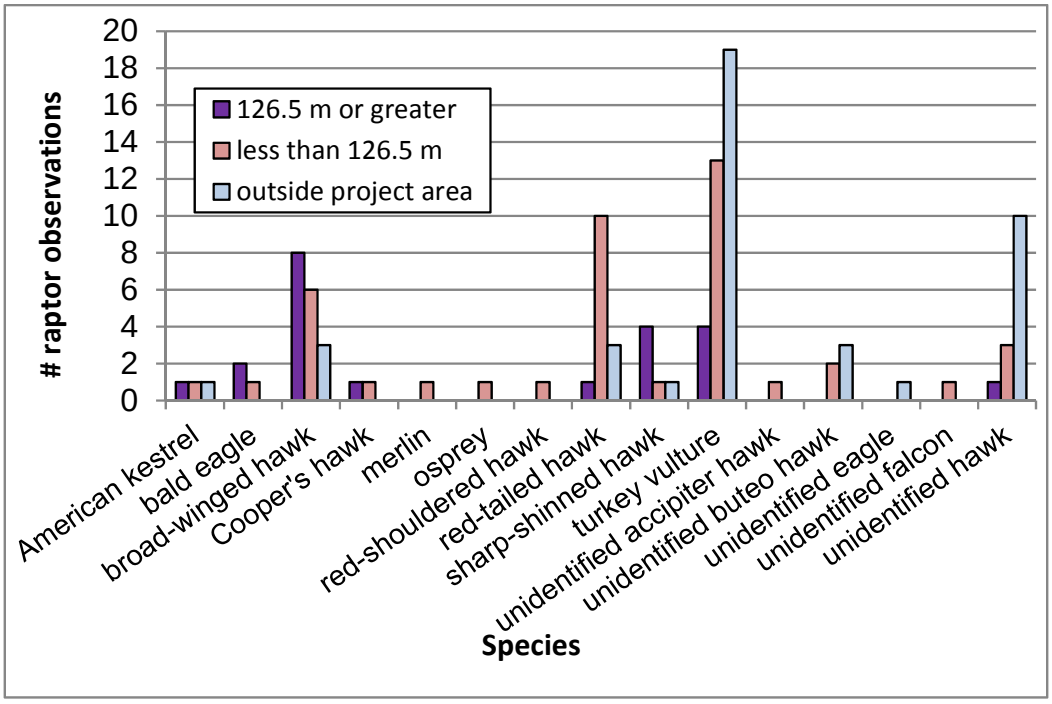

Figure 4-9. Number of individuals observed at heights above or below 126.5 m at Record Hill, Fall 2012

4.4.4 Flight Behavior

As individual raptors traveled within or beyond the Project area, they often exhibited multiple flight behaviors. As a result, the summary of flight behaviors includes more flight behaviors than the number of individual observations. In spring and fall, soaring and gliding were the most common behaviors (n=39; 89% in spring) (Table 4-6); (n=140; 79% in fall) (Table 4-7). No territorial or courtship behaviors were documented in either season. In fall, one unknown accipiter was observed flying past Turbine 13 at a distance of approximately 50 m, then perching in a tree for two minutes before taking flight and flying north behind the tree line. Note that observations in fall were observed in more locations than in spring.

All 5 bald eagle observations exhibited soaring or gliding behavior.

Table 4-6. Raptor behaviors summarized by location in study area and flight position at the Record Hill Wind Project, Spring 2012

Behavior		Soaring, Gliding						Powered Flight						Foraging Behaviors						territorial or courtship behavior						Perched					
Flight position where behavior observed		A1	A2	A3	B	C	D	A1	A2	A3	B	C	D	A1	A2	A3	B	C	D	A1	A2	A3	B	C	D	A1	A2	A3	B	C	D
Location in Study Area	Access Road Nr. Mine Notch	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flathead Mtn.	2	4	1	2	1	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Gate	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mine Notch	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Project Ridge	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Record Hill	0	0	1	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Roxbury Pond	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	T12 Slope	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total behavior obs = 44		2	7	3	22	5	0	0	1	0	1	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 4-7. Raptor behaviors summarized by location in study area and flight position at the Record Hill Wind Project, Fall 2012

Behavior		Soaring, Gliding						Powered Flight						Foraging Behaviors						territorial or courtship behavior						Perched					
Flight position where behavior observed		A1	A2	A3	B	C	D	A1	A2	A3	B	C	D	A1	A2	A3	B	C	D	A1	A2	A3	B	C	D	A1	A2	A3	B	C	D
Location in Study Area	Access Road Nr. Mine Notch	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flathead Mtn	17	18	5	24	7	1	3	6	3	7	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	1	0	0
	Mine Notch	0	1	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Partridge Peak	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Project Ridge	0	3	1	3	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Record Hill	1	4	0	3	13	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Roxbury Notch	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	T12 Slope	0	0	1	7	2	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Unnamed Hill E. of Bunker Pond	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Valley	0	0	0	1	5	10	0	0	0	1	1	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

Based on their flight behaviors and direction of travel, raptor observations were categorized as either migrants or non-migrants; if the observer was unsure of whether or not an observation was migrating, migrant status was recorded as undetermined.

Of the total birds observed in spring and fall, 30% (n=42) were believed to be migrating. These observations were characterized by direct, long-distance flights, or diagnostic migratory flight behaviors, such as circle soaring and linear soaring. In spring, 4 observations (11%) were suspected to be actively migrating (Table 4-7). In fall, 38 observations (36%) were suspected to be actively migrating (Table 4-8). The majority of migrating raptor observations in fall were broad-winged hawk observations (34%; n=13). The majority of non-migrating raptor observations in fall were turkey vulture observations (50%; n=31). One of the 5 bald eagle observations was suspected to be actively migrating.

Table 4-8. Observations of raptors suspected to be actively migrating at the Record Hill Wind Project, Spring 2012.

Species	not actively migrating	actively migrating	undetermined	TOTAL
bald eagle	2			2
broad-winged hawk	3	2		5
red-shouldered hawk		1		1
sharp-shinned hawk			1	1
turkey vulture	26			26
unidentified buteo hawk		1		1
TOTAL	**31**	**4**	**1**	**36**

Table 4-9. Observations of raptors suspected to be actively migrating at the Record Hill Wind Project, Fall 2012

Species	not actively migrating	actively migrating	undetermined	TOTAL
American kestrel	2	1		**3**
bald eagle	2	1		**3**
broad-winged hawk	2	13	2	**17**
Cooper's hawk	1	1		**2**
merlin		1		**1**
osprey		1		**1**
red-shouldered hawk		1		**1**
red-tailed hawk	9	5		**14**
sharp-shinned hawk	1	5		**6**
turkey vulture	31	5		**36**
unidentified accipiter hawk	4	1		**5**
unidentified buteo hawk	1			**1**
unidentified eagle		1		**1**
unidentified falcon	8	2	4	**14**
unidentified hawk	1			**1**
TOTAL	**62**	**38**	**6**	**106**

4.4.5 Turbine and Avoidance Data

Of the 36 raptor observations in spring, the majority of birds (19%; n=7) occurred closest to Turbines 11 or Turbine 19 (Appendix D Table 7). For those observations for which distance from nearest turbine was recorded (n=13; 36% of observations), the majority (8%; n=3) occurred approximately 100 m or 300 m from the nearest turbine (Figure 4-10; Appendix D Table 8).

Of the 106 raptor observations in fall, the majority of birds (30%; n=32) occurred closest to the raptor observation location at Turbine 12 (Appendix D Table 9). For those observations for which distance from nearest turbine was recorded (n=93; 88% of observations), the majority (35%; n=37) occurred between 50 to 100 m from the nearest turbine (Figure 4-11; Appendix D Table 10).

The 5 bald eagle observations occurred nearest Turbines 1, 8, 12, and 22. Bald eagle observations occurred between 50 and > 1000 m from the nearest turbine.

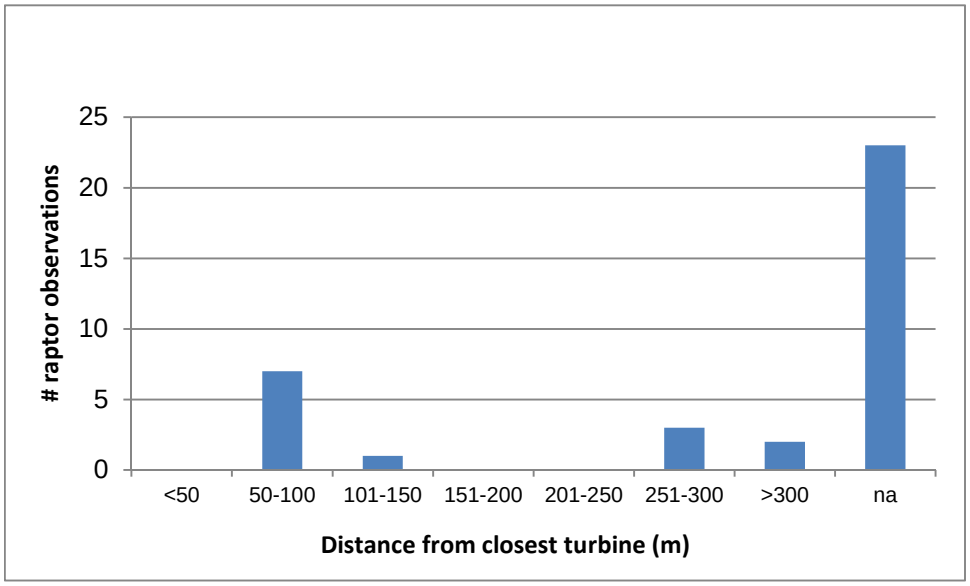

Figure 4-10. Number of individuals observed at distances from the nearest turbine at the Record Hill Wind Project, Spring 2012

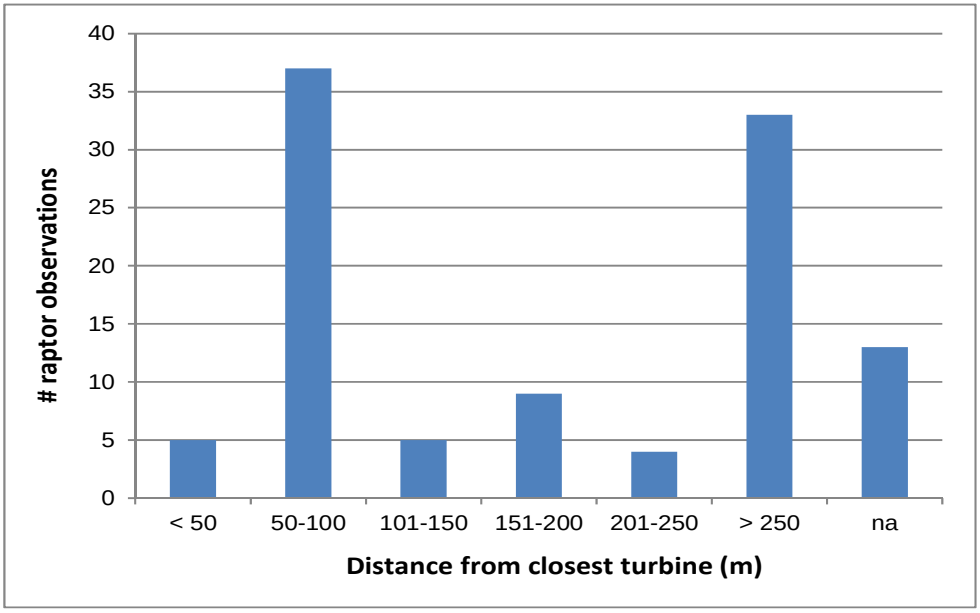

Figure 4-11. Number of individuals observed at distances from the nearest turbine at the Record Hill Wind Project, Fall 2012

Of the 142 observations in spring and fall, only 3 observations showed noticeable, albeit slight, changes in behavior while encountering turbines (Table 4-10). All 3 observations occurred near Flathead Mountain and flew at heights below turbine height for at least a portion of their flight. In total, these observations spent 39 seconds below turbine height. These observations were within 50 meters or less of the nearest turbine and in each case, Project turbines were spinning.

Table 4-10. Observed turbine avoidance behaviors, Record Hill Wind Project, 2012

Date	Species	Location in study area	Position	Minimum Flight Height	Maximum Flight Height	Flight Behavior	Azimuth	Actively migrating (Y/N)	Time over turbine area (min: sec)	Time below max turbine height (min: sec)
5/7	turkey vulture	Flathead Mtn	A1, A3	75	125	soaring, gliding	NW	N	0:00:04	0:00:04
10/5	turkey vulture	Flathead Mtn	A1	50	75	soaring, gliding	S	N	0:00:20	0:00:20
10/9	merlin	Flathead Mtn	A3, B	75	100	powered flight	W	Y	0:00:15	0:00:15

Date	Species	# closest turbine	Distance to closest turbine (m)	If crossed ridge, above or between?	Turbine spinning?	Behavioral notes
5/7	turkey vulture	8	50	btw	Y	Slight adjustment away from T8 during crossing.
10/5	turkey vulture	13	25	na	Y	Wove in and out of turbines, slight movements to avoid
10/9	merlin	11	50	btw	Y	Dipped a bit below blade height upon approaching it.

4.4.6 Incidental Observations

Appendix D Table 11 lists raptor species incidentally observed during the other on-site field surveys in 2012 (i.e., fatality monitoring and acoustic bat surveys). Observers documented 28 raptor observations of 7 raptor species, including 1 barred owl (*Strix varia*). One bald eagle observation occurred incidentally on May 6 over Roxbury Pond; this individual did not occur in the Project area. Of the 28 raptor observations, 19 (68%) occurred in the Project area. Most observations in the Project area occurred near Turbines 21 and 22 (32%; n=6). Turbines were spinning when 13 observations (68%) occurred in the Project area. For these observations, average flight height was 30 m (98 ft), indicating that these observations occurred more frequently between turbines rather than above turbines even when turbines were spinning. No avoidance or behavioral modifications around turbines were observed and no incidental raptor observations collided with Project turbines.

Appendix D Table 12 lists non-raptor avian species incidentally observed during spring and fall surveys. Stantec incidentally observed 38 non-raptor avian species. No incidentally-observed birds are federal or state-listed species (MDIFW 2003). Observers recorded 4 state species of special concern (MDIFW 2011): black-and-white warbler (*Mniotilta varia*), chestnut-sided warbler (*Setophaga pensylvanica*), least flycatcher (*Empidonax minimus),* and white-throated sparrow (*Zonotrichia albicollis*).

4.5 DISCUSSION

Passage rates of raptors observed during the 2012 surveys were comparable to results of pre-construction migration surveys conducted in 2007 and 2008 at the site. Passage rate in spring 2008 was 1.2 and in spring 2012 was 0.5. Passage rate in fall 2007 was 1.1 and in fall 2012 was 1.2. Species composition was comparable, however peregrine falcon (*Falco peregrinus*), northern harrier (*Circus cyaneus*), and northern goshawk (*Accipiter gentilis*) were not detected during the 2012 surveys. Annual variation in weather, timing of migration movements, and regional raptor populations may influence the variability in results of migration surveys among survey years.

Interestingly, the same number of eagle observations (n=5) occurred during both the pre- and post-construction migration surveys (Table 4-11). No eagle observations during spring 2008 or spring 2012 appeared to be actively migrating. Three of the 3 eagle observations (100%) in fall 2007 and 1 of the 3 eagle observations (33%) in 2012 appeared to be actively migrating. The level of bald eagle activity during migration periods did not appear to considerably change as a result of Project construction. It should be noted that Stantec conducted a summer and early fall eagle observation survey pre-construction in 2009. As the eagle nest on French Island on Roxbury Pond was inactive in 2012, IFW indicated that summer surveys in 2012 were not required; therefore we cannot compare summer bald eagle activity pre- and post-construction.

Table 4-11. Comparison of Pre- and Post-Construction Eagle Activity at the Record Hill Wind Project.

Survey	Pre-Construction		Post-Construction	
	Spring 2008	Fall 2007	Spring 2012	Fall 2012
# Survey Days	15	14	10	11
# Survey Hours	97	85.75	69.5	75
Survey Timing	3/11 - 5/27	9/3-10/15	3/20-5/18	9/6-11/6
# Bald Eagle Obs.	**2**	**3**	**2**	**3**
Eagle ages*	2 Sub-A	2 A, 1 J	2 A	1 Sub-A, 1 A, 1 non-J
Obs. Locations	Project Ridge and West Valley	Flathead Mtn.	Roxbury Pond and Record Hill	Project ridge, Flathead Mtn., and Record Hill
Citation	Stantec 2008a	Stantec 2008b	*This report*	

*Sub A = sub-adult; A=adult; J=juvenile; non-Juv=sub-adult or adult

Stantec Consulting. 2008a. Spring 2008 Bird and Bat Migration Survey Report Breeding Bird, Raptor, and Acoustic Bat Surveys for the Record Hill Wind Project Roxbury, Maine. Prepared for Record Hill Wind, LLC.

Stantec Consulting. 2008b. Fall 2007 Migration Survey Report. Visual, acoustic, and radar surveys of bird and bat migration conducted at the proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.

Raptor studies conducted at operational wind projects in the U.S. and in Maine (i.e., Stetson Mountain Wind Project [Stantec 2009] and the Rollins Wind Project [Stantec in prep.]) indicate that raptors continue to use the area surrounding wind developments post-construction. At Stetson Mountain, species including red-tailed hawk, Cooper's hawk, and broad-winged hawk were suspected to be breeding within the Project area or the direct vicinity (Stantec 2009). Red-tailed hawks were observed in the vicinity of spinning turbines at distances as close as 20 m (66 ft), and as close as 5 m (16 ft) when the closest turbines were not spinning. Broad-winged hawks were observed at distances as close as 20 m from spinning turbines. Cooper's hawk were observed as close as 40 m (131 ft) from spinning turbines, and turkey vulture as close as 20 m from spinning turbines. Similarly at the Record Hill Project in 2012, observations of red-tailed hawk, broad-winged hawk, turkey vulture, red-shouldered hawk, and sharp-shinned hawk occurred as close as < 50 m from spinning blades. Coopers hawk occurred as close as 50 m. At Stetson Mountain, for those birds within turbine areas and at heights below 119 m, the majority of birds were at distances of 51 to 100 m. Similarly, in fall 2012 at the Project, for those observations for which distance from nearest turbine was recorded (n=93; 88% of observations), the majority (35%; n=37) occurred between 50 to 100 m from the nearest turbine.

The percent of raptor observations below turbine height varied between pre- and post-construction years, decreasing from 64% to 36% in spring and from 89% to 61% in fall. Flight paths and fight characteristics such as height vary from year to year due to variations in migration activity, weather, and other factors; however these data may suggest that the presence of turbines caused more raptors near the Project ridge to fly higher. However, raptors that crossed the Project ridge in 2012 more frequently flew between turbines than above turbines. A total of 54 Project ridge crossings occurred. Average minimum flight height of ridge crossing observations was 118 m (387 ft) for crossings at high points and 84 m (276 ft) for crossings at low points. Of the 54 crossings, 42 (78%) occurred between turbines (below turbine height), and 12 (22%) occurred above turbine height.

Researchers have documented movement patterns and flight behaviors of raptors and eagles at other facilities including the Buffalo Ridge facility in Minnesota and the Pillar Mountain Wind Project in Alaska. These studies documented direct observations of turbine-avoidance behavior by raptors and eagles. At Buffalo Ridge, birds seen flying through turbine strings adjusted their flight when turbine blades were rotating and typically made no adjustments when turbines were not operating (Osborn et al. 1998). Though eagles continued to use the airspace over the ridge at Pillar Mountain, eagles generally avoided crossing between turbines (Sharp et al. 2010). These turbine-collision avoidance behaviors have been documented at other modern wind facilities (Madders and Whitfield 2006, Chamberlain et al. 2006). These turbine-collision avoidance behaviors have been documented at other modern wind facilities (Madders and Whitfield 2006, Chamberlain et al. 2006). At the Project, 3 observations, 2 turkey vulture observations and 1 merlin observation, showed noticeable, slight, changes in behavior while encountering turbines. These observations occurred over Flathead Mountain within 50 m or less of the nearest turbine, and in each case, Project turbines were spinning. It should be noted that the observation of turbine avoidance behaviors and where they were observed is subject to observer bias, as these behaviors, because they may be slight, are more decipherable closer to

the observer. Slight changes in flight paths would not be as easily discernible in raptors at a distance. Eagles continued to use the Project ridge and no eagles exhibited avoidance behavior.

No eagle or raptor fatalities were documented at Record Hill in 2012 despite continued use of the Project area by raptors. Several recent studies conducted in the U.S., outside of California, have documented relatively low raptor mortality with less than 80 total raptor and owl fatalities documented by nearly 50 studies at over 30 different wind projects throughout the U.S. (Appendix D Table 13). There have been at least 5 confirmed bald eagle fatalities at wind projects in North America and one additional potential eagle turbine-collision fatality at a wind project in Minnesota. In addition, one bald eagle was injured during a turbine collision at a project in Iowa (USFWS, unpublished data). However, to-date there have been very few raptor fatalities and specifically, no bald eagle fatalities, documented at operational wind projects in Maine. Hawks and eagles are diurnally active and are expected to generally avoid large obstructions within their flight paths, when possible. Collision avoidance is not always possible as there have been some documented raptor fatalities at Projects in the eastern U.S.; however, raptor fatalities are rare at operational wind Projects in Maine.

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Appendix A

Figures 1-4 Aerial Photos of Search Turbines

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Client/Project
Record Hill Wind Project
Roxbury, Maine

Figure
1 - 1

Title
Turbine Search Plots

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Figure
1 - 2

Title
Turbine Search Plots

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Figure
1 - 3

Title
Turbine Search Plots

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Client/Project
Record Hill Wind Project
Roxbury, Maine

Figure
1 - 4

Title
Turbine Search Plots

1/31/2013

Appendix B

Photos 1-7 Game Camera Photos

Photo 1. Record Hill Trial 1 Turbine 15 – common raven

Photo 2. Record Hill Trial 2 Turbine 6 - wild turkey

Photo 3. Record Hill Trial 2 Turbine 6 – snowshoe hair

Photo 4. Record Hill Trial 2 Turbine 12 – red fox

Photo 5. Record Hill Trial 2 Turbine 14 – red fox

Photo 6. Record Hill Trial 3 Turbine 7 – red fox

Photo 7. Record Hill Trial 3 Turbine 10 - red fox with hoary bat

Appendix C

Bat Acoustic Survey Result Tables

Appendix C Table 1. Summary of acoustic bat data and weather during each survey night at the Record Hill Turbine 1 detector – 2012

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (celsius)
04/16/12	0												**0**	6.4	18.8
04/17/12	0												**0**	8.5	4.6
04/18/12	0												**0**	3.5	6.5
04/19/12	0												**0**	3.7	8.9
04/20/12	0												**0**	6.5	12.8
04/21/12	0												**0**	5.6	5.8
04/22/12	0												**0**	10.1	0.8
04/23/12	0												**0**	6.9	7.3
04/24/12	0												**0**	6.3	4.1
04/25/12	0												**0**	5.7	2.5
04/26/12	0												**0**	4.9	4.1
04/27/12	0												**0**	16.6	-3.7
04/28/12	0												**0**	7.1	-0.8
04/29/12	1												**0**	9.8	0.5
04/30/12	1												**0**	3.3	5.7
05/01/12	0												**0**	3.5	1.7
05/02/12	0												**0**	2.8	4.1
05/03/12	0												**0**	2.2	6.5
05/04/12	0												**0**	2.8	7.0
05/05/12	0												**0**	3.8	7.8
05/06/12	0												**0**	2.3	9.0
05/07/12	0												**0**	4.6	10.4
05/08/12	0												**0**	2.1	4.5
05/09/12	0												**0**	3.6	10.6
05/10/12	0												**0**	9.0	5.3
05/11/12	0												**0**	5.6	7.4
05/12/12	0												**0**	4.7	13.5
05/13/12	0												**0**	2.1	12.0
05/14/12	1												**0**	4.2	12.1
05/15/12	1												**0**	3.0	11.8
05/16/12	1												**0**	7.2	11.1
05/17/12	1												**0**	6.3	7.7
05/18/12	1										1		**1**	2.7	13.5
05/19/12	1			2	1						3		**6**	3.3	18.2
05/20/12	1									1	7		**8**	5.0	18.3
05/21/12	1										2		**2**	3.2	13.7
05/22/12	1												**0**	2.3	14.4
05/23/12	1				6						6		**12**	4.2	16.1
05/24/12	1												**0**	3.9	13.1
05/25/12	1												**0**	5.8	14.7
05/26/12	1			1							3		**4**	3.1	14.5
05/27/12	1												**0**	3.5	12.8
05/28/12	1												**0**	4.1	11.1
05/29/12	1										1		**1**	3.3	12.0
05/30/12	1	1		1							6		**8**	3.6	14.0
05/31/12	1										1		**1**	4.5	10.0
06/01/12	1				31						34		**65**	3.9	12.4
06/02/12	1												**0**	10.3	7.6
06/03/12	1												**0**	10.3	7.4
06/04/12	1												**0**	3.5	7.5
06/05/12	1				7						6		**13**	3.4	9.4
06/06/12	1				66						7		**73**	1.6	10.1
06/07/12	1			1									**1**	3.3	10.1
06/08/12	1										1		**1**	5.7	10.7
06/09/12	1			1	24						8		**33**	4.8	14.2
06/10/12	1				16						5		**21**	4.3	13.7
06/11/12	1				439						118		**557**	2.8	13.7
06/12/12	1				31						11		**42**	6.9	15.2
06/13/12	1	1	1		55						2		**59**	4.5	13.1
06/14/12	1			16	306						42		**364**	4.1	14.1
06/15/12	1	17		2	211				2		68		**300**	2.6	14.9
06/16/12	1			2	57						19		**78**	4.0	11.9
06/17/12	1			1	17						5		**23**	3.7	9.7
06/18/12	1				70						41		**111**	3.1	11.1
06/19/12	1	19		146	13						5		**183**	6.1	19.4
06/20/12	1		1		7					2	6		**16**	7.1	22.9
06/21/12	1			2	235						93		**330**	3.9	23.1
06/22/12	1				248	2					1		**251**	3.9	19.5
06/23/12	1	1			54						3		**58**	5.1	14.4
06/24/12	1	9	1	32	160						31		**233**	4.1	16.5
06/25/12	1				179						17		**196**	2.0	12.8
06/26/12	1					1							**1**	8.5	12.2
06/27/12	1				9						2		**11**	7.0	13.7
06/28/12	1				34	1					14		**49**	3.7	16.7
06/29/12	1	8	2	3		1	1				2		**17**	8.3	21.0
06/30/12	1	1	2	1	7					1	3		**15**	n/a	n/a
07/01/12	1				9	1					1		**11**	n/a	n/a
07/02/12	1				11		1			1	3		**16**	4.2	15.0
07/03/12	1	1		15	5						7		**28**	3.4	17.5
07/04/12	1						1			2			**3**	4.8	16.6
07/05/12	1				12		1			5			**18**	3.7	17.8
07/06/12	1		1		9						5		**15**	5.9	20.9
07/07/12	1		2				5		4	3	1		**15**	5.4	17.6
07/08/12	1				5		1		1	3	6		**16**	5.9	13.7
07/09/12	1				12	1	5			11	3		**32**	5.8	14.0
07/10/12	1	1	2	5	3	1	4		1	4	2		**23**	4.0	16.4
07/11/12	1		16	1	3		5			13	6		**44**	3.5	18.4
07/12/12	1	2	61	13	3	1	9		1	8	12		**110**	3.4	20.6
07/13/12	1	16		109	8		10		2	7	26		**178**	3.8	21.7
07/14/12	1	16	24	3	2		7			9	3		**64**	3.5	23.3
07/15/12	1	14		12	9		1			5	17		**58**	3.1	20.0
07/16/12	1	3	2	4	13	1	2		1	5	10		**41**	2.9	19.8
07/17/12	1	5	3				3			7	1		**19**	8.7	20.2
07/18/12	1	1			1	2	2			5	1		**12**	5.8	13.5
07/19/12	1					1	8		2	14	3		**28**	5.1	12.5
07/20/12	1	4	5	34	2	1	3		2	21	7		**79**	2.7	16.8

cont.

Appendix C Table 1 *cont.*

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	**Operational?**	**BBSH**	**Big brown**	**Silver-haired**	**Hoary**	**MYSP**	**Eastern red**	**Tri-colored**	**RBTB**	**HFUN**	**LFUN**	**UNKN**	**Total**	**Wind Speed (m/s)**	**Temperature (celsius)**
07/21/12	1			10						9	6		**25**	4.4	17.3
07/22/12	1	10		19	10		5		1	5	5		**55**	3.5	20.7
07/23/12	1	2		6	1		1			2	3		**15**	5.5	17.8
07/24/12	1	1					7			5			**13**	7.7	13.9
07/25/12	1			1	6		9		2	14	1		**33**	4.0	15.3
07/26/12	1	1		37	1		4			25	7		**75**	2.4	15.2
07/27/12	1	16	1	21	8	1	3			12	4		**66**	2.7	19.3
07/28/12	1			12	54		4		2	23	26		**121**	2.2	17.1
07/29/12	1			3	4	2	9			27	3		**48**	3.0	15.8
07/30/12	1	5	9	85	46	1	9		2	15	39		**211**	2.9	19.0
07/31/12	1			5	5		10	1	27	18	4		**70**	2.9	15.8
08/01/12	1			5		1	1	1	6	8	4		**26**	1.5	17.9
08/02/12	1	1	5	45	2		5		1	14	16		**89**	3.2	20.3
08/03/12	1	3	3	21	22		3		1	11	4		**68**	4.5	19.9
08/04/12	1		4	2	14	1	2			3	10		**36**	4.0	20.5
08/05/12	1	1			2	1	6		1	13			**24**	8.1	18.8
08/06/12	1			2	2		1			2	2		**9**	4.0	13.9
08/07/12	1	2	1	4	15	1	12		2	23	7		**67**	3.8	17.8
08/08/12	1	6	2	21	13	1	1			10	5		**59**	2.7	20.6
08/09/12	1						2			7			**9**	3.6	17.3
08/10/12	1						1			3			**4**	5.7	17.4
08/11/12	1						7			8			**15**	3.6	17.6
08/12/12	1			2			3		1	7	1		**14**	2.7	17.4
08/13/12	1	1	2		6		5			16	2		**32**	3.9	17.8
08/14/12	1	3	9	39	3		2		2	7	8		**73**	2.3	18.8
08/15/12	1	4	7	33	16		2			10	7		**79**	1.8	17.4
08/16/12	1			2	3	1		1		6	1		**14**	4.9	15.1
08/17/12	1	4		107	2	1	12	2	1	21	16		**166**	5.3	16.7
08/18/12	1			1			1			8	1		**11**	6.2	13.6
08/19/12	1		1	4	2	1			3	8	10		**29**	1.9	15.2
08/20/12	1		3	2	2	1	1		1	2	1		**13**	3.9	15.9
08/21/12	1	5	6				2		6	10			**29**	2.6	14.8
08/22/12	1	5	7	2	1	1	1		4	10	4		**35**	3.7	16.5
08/23/12	1	54	2	7	4				5	19	8		**99**	3.5	16.2
08/24/12	1	11	24	27	3		7			13	9		**94**	2.4	17.9
08/25/12	1	4	2	405	7	1	24		4	10	34		**491**	4.5	16.9
08/26/12	1	5	2	208	5		8		5	28	51		**312**	3.3	18.7
08/27/12	1	2		80			1	1	1	7	7		**99**	4.6	18.0
08/28/12	1			4				1			1		**6**	9.2	11.6
08/29/12	1			6			9			5	3		**23**	8.0	13.6
08/30/12	1	1		7	1		47		15	32	1		**104**	12.0	19.1
08/31/12	1	1		7		1	19		5	14	2		**49**	4.0	16.6
09/01/12	1	2		18			10			4	7		**41**	3.3	14.9
09/02/12	1			68	1		5		2	7	13		**96**	2.1	13.0
09/03/12	1	3	33	238	1	1	2			3	30		**311**	3.0	14.4
09/04/12	1	1		36				1		1	8		**47**	3.2	14.7
09/05/12	1	1	2	80		1	10			13	8		**115**	1.7	15.4
09/06/12	1	2		121					1	1	9		**134**	3.8	17.3
09/07/12	1			119					2	9	15		**145**	3.5	18.4
09/08/12	1			1			2			6			**9**	9.4	13.8
09/09/12	1			2					1	1	1		**5**	6.2	9.8
09/10/12	1						1						**1**	8.4	8.5
09/11/12	1			13			31		4	35	3		**86**	3.9	11.8
09/12/12	1			18			1			8	2		**29**	5.3	15.6
09/13/12	1	29		56	1		2	1	1	5	16		**111**	3.2	17.5
09/14/12	1			3			4		1	3			**11**	3.8	15.6
09/15/12	1					1	1						**2**	9.8	6.6
09/16/12	1								2	1	1		**4**	6.0	7.1
09/17/12	1			1		1	10		1	14	1		**28**	3.3	12.8
09/18/12	1									1			**1**	9.3	15.9
09/19/12	1									2			**2**	4.0	5.7
09/20/12	1			1			1		1	3			**6**	4.2	8.2
09/21/12	1						1			2			**3**	2.5	9.2
09/22/12	1			10			2			8			**20**	4.8	13.3
09/23/12	1									3			**3**	4.1	6.5
09/24/12	1						1			1			**2**	4.0	7.4
09/25/12	1						3			1			**4**	4.6	11.4
09/26/12	1						1			3			**4**	5.7	10.0
09/27/12	1	9		10		5				10	11		**45**	3.3	5.0
09/28/12	1			1									**1**	4.2	6.7
09/29/12	1			3			2			2			**7**	4.6	9.3
09/30/12	1									3			**3**	5.5	9.1
10/01/12	1			1						1			**2**	9.0	10.8
10/02/12	1	1		4			7			5			**17**	2.6	13.8
10/03/12	1						1			2			**3**	2.8	12.8
10/04/12	1												**0**	3.5	11.9
10/05/12	1			2			1			1	1		**5**	4.2	15.2
10/06/12	1												**0**	10.1	5.9
10/07/12	1												**0**	4.1	3.3
10/08/12	1									1			**1**	2.3	4.2
10/09/12	1												**0**	2.9	5.5
10/10/12	1												**0**	10.0	5.4
10/11/12	1												**0**	7.0	4.2
10/12/12	1												**0**	10.0	-1.8
10/13/12	1												**0**	5.1	1.6
10/14/12	1												**0**	3.6	6.4
10/15/12	1						2			1			**3**	4.8	11.3
10/16/12	1												**0**	9.7	2.1
10/17/12	1												**0**	2.8	8.8
10/18/12	1												**0**	3.8	7.4
10/19/12	1												**0**	6.1	13.0
10/20/12	1									2			**2**	6.3	9.4
10/21/12	1												**0**	14.0	6.5
10/22/12	1												**0**	11.3	5.8
10/23/12	1												**0**	5.1	3.1
By Species		**316**	**248**	**2455**	**2653**	**39**	**416**	**9**	**130**	**780**	**1127**	**0**	**8173**		
By Guild		**3019**			**2653**	**39**	**555**			**1907**					
		BBSH			**HB**	**MYSP**	**RBTB**			**UNKN**			**Total**		

* 1 = Detector functioned for then entire night; 0 = Non-operational for all or part of the night

Appendix C Table 2. Summary of acoustic bat data and weather during each survey night at the Record Hill Turbine 12 detector – 2012

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (celsius)
04/17/12	1												**0**	8.5	4.6
04/18/12	1												**0**	3.5	6.5
04/19/12	1										1		**1**	3.7	8.9
04/20/12	1												**0**	6.5	12.8
04/21/12	1												**0**	5.6	5.8
04/22/12	1												**0**	10.1	0.8
04/23/12	1												**0**	6.9	7.3
04/24/12	1										1		**1**	6.3	4.1
04/25/12	1												**0**	5.7	2.5
04/26/12	1												**0**	4.9	4.1
04/27/12	1												**0**	16.6	-3.7
04/28/12	0												**0**	7.1	-0.8
04/29/12	0												**0**	9.8	0.5
04/30/12	0												**0**	3.3	5.7
05/01/12	0												**0**	3.5	1.7
05/02/12	0												**0**	2.8	4.1
05/03/12	0												**0**	2.2	6.5
05/04/12	0												**0**	2.8	7.0
05/05/12	0												**0**	3.8	7.8
05/06/12	0												**0**	2.3	9.0
05/07/12	0												**0**	4.6	10.4
05/08/12	0												**0**	2.1	4.5
05/09/12	1												**0**	3.6	10.6
05/10/12	1												**0**	9.0	5.3
05/11/12	1												**0**	5.6	7.4
05/12/12	1	1											**1**	4.7	13.5
05/13/12	1										1		**1**	2.1	12.0
05/14/12	1												**0**	4.2	12.1
05/15/12	1												**0**	3.0	11.8
05/16/12	1												**0**	7.2	11.1
05/17/12	1												**0**	6.3	7.7
05/18/12	1			1									**1**	2.7	13.5
05/19/12	1	1									1		**2**	3.3	18.2
05/20/12	1				1						2		**3**	5.0	18.3
05/21/12	1										1		**1**	3.2	13.7
05/22/12	1												**0**	2.3	14.4
05/23/12	1			1	1						1		**3**	4.2	16.1
05/24/12	1												**0**	3.9	13.1
05/25/12	1												**0**	5.8	14.7
05/26/12	1										1		**1**	3.1	14.5
05/27/12	1												**0**	3.5	12.8
05/28/12	1			2	3						1		**6**	4.1	11.1
05/29/12	1												**0**	3.3	12.0
05/30/12	1				1						1		**2**	3.6	14.0
05/31/12	1				1								**1**	4.5	10.0
06/01/12	1				4								**4**	3.9	12.4
06/02/12	1												**0**	10.3	7.6
06/03/12	1												**0**	10.3	7.4
06/04/12	1												**0**	3.5	7.5
06/05/12	1				6						2		**8**	3.4	9.4
06/06/12	1	1		1	1						1		**4**	1.6	10.1
06/07/12	1				1								**1**	3.3	10.1
06/08/12	1			2							2		**4**	5.7	10.7
06/09/12	1			1	1								**2**	4.8	14.2
06/10/12	1										1		**1**	4.3	13.7
06/11/12	1												**0**	2.8	13.7
06/12/12	1										1		**1**	6.9	15.2
06/13/12	1	2											**2**	4.5	13.1
06/14/12	1	1			3						15		**19**	4.1	14.1
06/15/12	1		1	13							8		**22**	2.6	14.9
06/16/12	1				1						1		**2**	4.0	11.9
06/17/12	1				2								**2**	3.7	9.7
06/18/12	1				3								**3**	3.1	11.1
06/19/12	1				2						2		**4**	6.1	19.4
06/20/12	1				2						1		**3**	7.1	22.9
06/21/12	1										1		**1**	3.9	23.1
06/22/12	1												**0**	3.9	19.5
06/23/12	1				1						2		**3**	5.1	14.4
06/24/12	1			2						1	3		**6**	4.1	16.5
06/25/12	1				1						4		**5**	2.0	12.8
06/26/12	1										1		**1**	8.5	12.2
06/27/12	1												**0**	7.0	13.7
06/28/12	1			1							1		**2**	3.7	16.7
06/29/12	1									1	3		**4**	8.3	21.0
06/30/12	1				1								**1**	ND	ND
07/01/12	1				1						1		**2**	ND	ND
07/02/12	1				2								**2**	4.2	15.0
07/03/12	1			9					2		3		**14**	3.4	17.5
07/04/12	1	1		2							1		**4**	4.8	16.6
07/05/12	1			1							5		**6**	3.7	17.8
07/06/12	1			2							2		**4**	5.9	20.9
07/07/12	1									1	3		**4**	5.4	17.6
07/08/12	1												**0**	5.9	13.7
07/09/12	0												**0**	5.8	14.0
07/10/12	0												**0**	4.0	16.4
07/11/12	0												**0**	3.5	18.4
07/12/12	0												**0**	3.4	20.6
07/13/12	0												**0**	3.8	21.7
07/14/12	0												**0**	3.5	23.3
07/15/12	0												**0**	3.1	20.0
07/16/12	1				1					1			**2**	2.9	19.8
07/17/12	1	1									2		**3**	8.7	20.2
07/18/12	1									1			**1**	5.8	13.5
07/19/12	1	1								1			**2**	5.1	12.5
07/20/12	1	2		1					1	1			**5**	2.7	16.8
07/21/12	1												**0**	4.4	17.3

cont.

Appendix C Table 2 *cont.*

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	**Operational?**	**BBSH**	**Big brown**	**Silver-haired**	**Hoary**	**MYSP**	**Eastern red**	**Tri-colored**	**RBTB**	**HFUN**	**LFUN**	**UNKN**	**Total**	**Wind Speed (m/s)**	**Temperature (celsius)**
07/22/12	1			1	1				1	2	1		**6**	3.5	20.7
07/23/12	1	1		2	1					1	2		**7**	5.5	17.8
07/24/12	1									2			**2**	7.7	13.9
07/25/12	1				1		2			3	2		**8**	4.0	15.3
07/26/12	1			7	1				1	35	5		**49**	2.4	15.2
07/27/12	1				1				3	4	1		**9**	2.7	19.3
07/28/12	1			1	1	1	16		13	78	7		**117**	2.2	17.1
07/29/12	1				1					1	1		**3**	3.0	15.8
07/30/12	1		2		4		2			4	5		**17**	2.9	19.0
07/31/12	1			1			2		4	11			**18**	2.9	15.8
08/01/12	0												**0**	1.5	17.9
08/02/12	0												**0**	3.2	20.3
08/03/12	0												**0**	4.5	19.9
08/04/12	0												**0**	4.0	20.5
08/05/12	0												**0**	8.1	18.8
08/06/12	0												**0**	4.0	13.9
08/07/12	0												**0**	3.8	17.8
08/08/12	0												**0**	2.7	20.6
08/09/12	0												**0**	3.6	17.3
08/10/12	0												**0**	5.7	17.4
08/11/12	0												**0**	3.6	17.6
08/12/12	0												**0**	2.7	17.4
08/13/12	0												**0**	3.9	17.8
08/14/12	0												**0**	2.3	18.8
08/15/12	0												**0**	1.8	17.4
08/16/12	0												**0**	4.9	15.1
08/17/12	0												**0**	5.3	16.7
08/18/12	0												**0**	6.2	13.6
08/19/12	0												**0**	1.9	15.2
08/20/12	0												**0**	3.9	15.9
08/21/12	1									2	1		**3**	2.6	14.8
08/22/12	1	1		7		1			1	1	1		**12**	3.7	16.5
08/23/12	1			1			1						**2**	3.5	16.2
08/24/12	1	2	1	12			1			3	4		**23**	2.4	17.9
08/25/12	1	1		4	1						2		**8**	4.5	16.9
08/26/12	1			13							2		**15**	3.3	18.7
08/27/12	1			3									**3**	4.6	18.0
08/28/12	1										1		**1**	9.2	11.6
08/29/12	1					1							**1**	8.0	13.6
08/30/12	1									1	1		**2**	12.0	19.1
08/31/12	1	3					2		1		1		**7**	4.0	16.6
09/01/12	1			5	1		1		1	1	2		**11**	3.3	14.9
09/02/12	1	1		4									**5**	2.1	13.0
09/03/12	1			114			3			4	16		**137**	3.0	14.4
09/04/12	1				1				1		2		**4**	3.2	14.7
09/05/12	1	4		3						2	2		**11**	1.7	15.4
09/06/12	1		1	2					1				**4**	3.8	17.3
09/07/12	1			4	1		1						**6**	3.5	18.4
09/08/12	1	1								3			**4**	9.4	13.8
09/09/12	1												**0**	6.2	9.8
09/10/12	1												**0**	8.4	8.5
09/11/12	1	1											**1**	3.9	11.8
09/12/12	1	2											**2**	5.3	15.6
09/13/12	1			6									**6**	3.2	17.5
09/14/12	1			2									**2**	3.8	15.6
09/15/12	1												**0**	9.8	6.6
09/16/12	1												**0**	6.0	7.1
09/17/12	1	1											**1**	3.3	12.8
09/18/12	1												**0**	9.3	15.9
09/19/12	1												**0**	4.0	5.7
09/20/12	1								1				**1**	4.2	8.2
09/21/12	1						2			2	1		**5**	2.5	9.2
09/22/12	1				1		1			2	2		**6**	4.8	13.3
09/23/12	1			2									**2**	4.1	6.5
09/24/12	1												**0**	4.0	7.4
09/25/12	1												**0**	4.6	11.4
09/26/12	1												**0**	5.7	10.0
09/27/12	1	1	1	2									**4**	3.3	5.0
09/28/12	1												**0**	4.2	6.7
09/29/12	1						1			1			**2**	4.6	9.3
09/30/12	1												**0**	5.5	9.1
10/01/12	1			1							1		**2**	9.0	10.8
10/02/12	1		1	1						1			**3**	2.6	13.8
10/03/12	1	1											**1**	2.8	12.8
10/04/12	1										1		**1**	3.5	11.9
10/05/12	0												**0**	4.2	15.2
10/06/12	0												**0**	10.1	5.9
10/07/12	0												**0**	4.1	3.3
10/08/12	0												**0**	2.3	4.2
10/09/12	0												**0**	2.9	5.5
10/10/12	0												**0**	10.0	5.4
10/11/12	0												**0**	7.0	4.2
10/12/12	0												**0**	10.0	-1.8
10/13/12	0												**0**	5.1	1.6
10/14/12	0												**0**	3.6	6.4
10/15/12	0												**0**	4.8	11.3
10/16/12	0												**0**	9.7	2.1
10/17/12	0												**0**	2.8	8.8
10/18/12	0												**0**	3.8	7.4
10/19/12	0												**0**	6.1	13.0
10/20/12	0												**0**	6.3	9.4
10/21/12	0												**0**	14.0	6.5
10/22/12	0												**0**	11.3	5.8
10/23/12	0												**0**	5.1	3.1
By Species		**31**	**7**	**237**	**56**	**3**	**35**	**0**	**31**	**171**	**141**	**0**	**712**		
By Guild		**275**			**56**	**3**	**66**			**312**					
		BBSH			**HB**	**MYSP**	**RBTB**			**UNKN**			**Total**		

Appendix D Table 3. Summary of acoustic bat data and weather during each survey night at the Record Hill Turbine 17 detector – 2012

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	Operational?	BBSH	Big brown	Silver-haired	Hoary	MYSP	Eastern red	Tri-colored	RBTB	HFUN	LFUN	UNKN	Total	Wind Speed (m/s)	Temperature (celsius)
04/18/12	1												**0**	3.5	6.5
04/19/12	1												**0**	3.7	8.9
04/20/12	1												**0**	6.5	12.8
04/21/12	1												**0**	5.6	5.8
04/22/12	1												**0**	10.1	0.8
04/23/12	1												**0**	6.9	7.3
04/24/12	1												**0**	6.3	4.1
04/25/12	1												**0**	5.7	2.5
04/26/12	1												**0**	4.9	4.1
04/27/12	0												**0**	16.6	-3.7
04/28/12	1												**0**	7.1	-0.8
04/29/12	1												**0**	9.8	0.5
04/30/12	1												**0**	3.3	5.7
05/01/12	1												**0**	3.5	1.7
05/02/12	1												**0**	2.8	4.1
05/03/12	1												**0**	2.2	6.5
05/04/12	1												**0**	2.8	7.0
05/05/12	1												**0**	3.8	7.8
05/06/12	1	1									1		**2**	2.3	9.0
05/07/12	1												**0**	4.6	10.4
05/08/12	1												**0**	2.1	4.5
05/09/12	1												**0**	3.6	10.6
05/10/12	1										1		**1**	9.0	5.3
05/11/12	1												**0**	5.6	7.4
05/12/12	1												**0**	4.7	13.5
05/13/12	1		1		5						7		**13**	2.1	12.0
05/14/12	1										1		**1**	4.2	12.1
05/15/12	1												**0**	3.0	11.8
05/16/12	1												**0**	7.2	11.1
05/17/12	1												**0**	6.3	7.7
05/18/12	1										2		**2**	2.7	13.5
05/19/12	1										4		**4**	3.3	18.2
05/20/12	1										3		**3**	5.0	18.3
05/21/12	1			1	3						17		**21**	3.2	13.7
05/22/12	1			1							9		**10**	2.3	14.4
05/23/12	1				3						8		**11**	4.2	16.1
05/24/12	1				1						17		**18**	3.9	13.1
05/25/12	1										1		**1**	5.8	14.7
05/26/12	1									1	12		**13**	3.1	14.5
05/27/12	1										2		**2**	3.5	12.8
05/28/12	1	1			3					1	15		**20**	4.1	11.1
05/29/12	1										3		**3**	3.3	12.0
05/30/12	1				1					3	14		**18**	3.6	14.0
05/31/12	1										1		**1**	4.5	10.0
06/01/12	1										17		**17**	3.9	12.4
06/02/12	1												**0**	10.3	7.6
06/03/12	1												**0**	10.3	7.4
06/04/12	1										3		**3**	3.5	7.5
06/05/12	1				4						63		**67**	3.4	9.4
06/06/12	1			1	3						54		**58**	1.6	10.1
06/07/12	1				3						11		**14**	3.3	10.1
06/08/12	1										7		**7**	5.7	10.7
06/09/12	1										10		**10**	4.8	14.2
06/10/12	1				4						24		**28**	4.3	13.7
06/11/12	1				2						24		**26**	2.8	13.7
06/12/12	1												**0**	6.9	15.2
06/13/12	1				2						3		**5**	4.5	13.1
06/14/12	1				6					2	10		**18**	4.1	14.1
06/15/12	1		1	4	1						13		**19**	2.6	14.9
06/16/12	1				4						16		**20**	4.0	11.9
06/17/12	1				5						8		**13**	3.7	9.7
06/18/12	1										10		**10**	3.1	11.1
06/19/12	1										4		**4**	6.1	19.4
06/20/12	1	1		3	1						12		**17**	7.1	22.9
06/21/12	1			4	1						3		**8**	3.9	23.1
06/22/12	1				2					1	2		**5**	3.9	19.5
06/23/12	1										1		**1**	5.1	14.4
06/24/12	1										2		**2**	4.1	16.5
06/25/12	1										2		**2**	2.0	12.8
06/26/12	1												**0**	8.5	12.2
06/27/12	1				10						67		**77**	7.0	13.7
06/28/12	1	1		2	15						57		**75**	3.7	16.7
06/29/12	1	24		7	10						119		**160**	8.3	21.0
06/30/12	1	3		10	13						58		**84**	ND	ND
07/01/12	1		2	2	5		1				44		**54**	ND	ND
07/02/12	1			3	24						54		**81**	4.2	15.0
07/03/12	1				10						55		**65**	3.4	17.5
07/04/12	1			4	11						59		**74**	4.8	16.6
07/05/12	1	3	3	7	15					1	81		**110**	3.7	17.8
07/06/12	1	2		3	11						114		**130**	5.9	20.9
07/07/12	1			103	8					1	61		**173**	5.4	17.6
07/08/12	1	4		35	5					1	61		**106**	5.9	13.7
07/09/12	1	4		15	3					1	32		**55**	5.8	14.0
07/10/12	1	3		11	2		1			2	20		**39**	4.0	16.4
07/11/12	1				2		2			2			**6**	3.5	18.4
07/12/12	1	8		8	2		2			3	14		**37**	3.4	20.6
07/13/12	1			3						2	7		**12**	3.8	21.7
07/14/12	1	15		21			3				18		**57**	3.5	23.3
07/15/12	1	81	3	118	20		3		1	9	28		**263**	3.1	20.0
07/16/12	1	23		70	5		1			3	36		**138**	2.9	19.8
07/17/12	1			6						1	3		**10**	8.7	20.2
07/18/12	1	9		15			1				11		**36**	5.8	13.5
07/19/12	1			9			1			3	7		**20**	5.1	12.5
07/20/12	1	1		7	1	1				1	11		**22**	2.7	16.8
07/21/12	1	7		3						1	14		**25**	4.4	17.3
07/22/12	1	3		14	12	1				3	33		**66**	3.5	20.7

cont.

Appendix C Table 3 *cont.*

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	**Operational?**	**BBSH**	**Big brown**	**Silver-haired**	**Hoary**	**MYSP**	**Eastern red**	**Tri-colored**	**RBTB**	**HFUN**	**LFUN**	**UNKN**	**Total**	**Wind Speed (m/s)**	**Temperature (celsius)**
07/23/12	1	1		11	1		1			2	3		**19**	5.5	17.8
07/24/12	1	1		2									**3**	7.7	13.9
07/25/12	1			2			1			2	1		**6**	4.0	15.3
07/26/12	1	3		11			4		1	9	3		**31**	2.4	15.2
07/27/12	1			4			1			2			**7**	2.7	19.3
07/28/12	1	9		8	4		7		2	34	13		**77**	2.2	17.1
07/29/12	1	1		2							4		**7**	3.0	15.8
07/30/12	1	2		9	7		2			1	8		**29**	2.9	19.0
07/31/12	1	1		7		2	4			35	2		**51**	2.9	15.8
08/01/12	1	3		9		1	2			5	1		**21**	1.5	17.9
08/02/12	1	5	3	16	10	1	2			4	12		**53**	3.2	20.3
08/03/12	1	6	2	58	5		2		2	4	39		**118**	4.5	19.9
08/04/12	1	6	2	2	4		1		1	3	6		**25**	4.0	20.5
08/05/12	1	3			4						2		**9**	8.1	18.8
08/06/12	1			2	2						2		**6**	4.0	13.9
08/07/12	1	4		22	4		2			3	10		**45**	3.8	17.8
08/08/12	1	7	2	68	3		1			8	16		**105**	2.7	20.6
08/09/12	1		5				2			1	1		**9**	3.6	17.3
08/10/12	1					1	1		8	17			**27**	5.7	17.4
08/11/12	1						1		4	2			**7**	3.6	17.6
08/12/12	1	3	2	201						5	36		**247**	2.7	17.4
08/13/12	1	8	1	10	13					6	22		**60**	3.9	17.8
08/14/12	1	2		26	2		2		1	3	5		**41**	2.3	18.8
08/15/12	1	3		19			1			3	6		**32**	1.8	17.4
08/16/12	1	3		9	1								**13**	4.9	15.1
08/17/12	1	1		173	18		1			1	64		**258**	5.3	16.7
08/18/12	1			9	1		1				3		**14**	6.2	13.6
08/19/12	1			13	1		1			2	6		**23**	1.9	15.2
08/20/12	1	35	68	81	2						67		**253**	3.9	15.9
08/21/12	1	7	4	10			1				5		**27**	2.6	14.8
08/22/12	1	8		4						1	5		**18**	3.7	16.5
08/23/12	1	26		26						1	39		**92**	3.5	16.2
08/24/12	1	1	6	2	2	1	3		1	12	3		**31**	2.4	17.9
08/25/12	1	135		62	2					1	59		**259**	4.5	16.9
08/26/12	1	3		29			1			6	21		**60**	3.3	18.7
08/27/12	1	13		13			2				6		**34**	4.6	18.0
08/28/12	1												**0**	9.2	11.6
08/29/12	1	1		2									**3**	8.0	13.6
08/30/12	1			1							4		**5**	12.0	19.1
08/31/12	1	5		3	1					2	4		**15**	4.0	16.6
09/01/12	1	2		6	2		1			7	2		**20**	3.3	14.9
09/02/12	1	16		14						4	20		**54**	2.1	13.0
09/03/12	1	1		2	1					7	2		**13**	3.0	14.4
09/04/12	1			1			3			1	2		**7**	3.2	14.7
09/05/12	1	1		4			1			1			**7**	1.7	15.4
09/06/12	1	1		13		1	2			3	3		**23**	3.8	17.3
09/07/12	1	5		3	1		1		1	33	2		**46**	3.5	18.4
09/08/12	1												**0**	9.4	13.8
09/09/12	1			1									**1**	6.2	9.8
09/10/12	1									1			**1**	8.4	8.5
09/11/12	1			1						4	3		**8**	3.9	11.8
09/12/12	1	1		1							1		**3**	5.3	15.6
09/13/12	1	1									2		**3**	3.2	17.5
09/14/12	1									1			**1**	3.8	15.6
09/15/12	1												**0**	9.8	6.6
09/16/12	1												**0**	6.0	7.1
09/17/12	1									10			**10**	3.3	12.8
09/18/12	1												**0**	9.3	15.9
09/19/12	1												**0**	4.0	5.7
09/20/12	1									18	1		**19**	4.2	8.2
09/21/12	1								1	10	1		**12**	2.5	9.2
09/22/12	1	1								4	1		**6**	4.8	13.3
09/23/12	1										1		**1**	4.1	6.5
09/24/12	1												**0**	4.0	7.4
09/25/12	1												**0**	4.6	11.4
09/26/12	1												**0**	5.7	10.0
09/27/12	1	1		1							1		**3**	3.3	5.0
09/28/12	1												**0**	4.2	6.7
09/29/12	1			2									**2**	4.6	9.3
09/30/12	1												**0**	5.5	9.1
10/01/12	1												**0**	9.0	10.8
10/02/12	1	1								2			**3**	2.6	13.8
10/03/12	1												**0**	2.8	12.8
10/04/12	1										1		**1**	3.5	11.9
10/05/12	1												**0**	4.2	15.2
10/06/12	1												**0**	10.1	5.9
10/07/12	1												**0**	4.1	3.3
10/08/12	1												**0**	2.3	4.2
10/09/12	1												**0**	2.9	5.5
10/10/12	1												**0**	10.0	5.4
10/11/12	1												**0**	7.0	4.2
10/12/12	1												**0**	10.0	-1.8
10/13/12	1												**0**	5.1	1.6
10/14/12	1												**0**	3.6	6.4
10/15/12	1												**0**	4.8	11.3
10/16/12	1												**0**	9.7	2.1
10/17/12	1												**0**	2.8	8.8
10/18/12	1												**0**	3.8	7.4
10/19/12	1												**0**	6.1	13.0
10/20/12	1												**0**	6.3	9.4
10/21/12	1												**0**	14.0	6.5
10/22/12	1												**0**	11.3	5.8
10/23/12	1												**0**	5.1	3.1
By Species		**531**	**105**	**1465**	**329**	**9**	**70**	**0**	**23**	**323**	**2002**	**0**	**4857**		
By Guild		**2101**			**329**	**9**	**93**			**2325**					
		BBSH			**HB**	**MYSP**	**RBTB**			**UNKN**			**Total**		

Appendix C Table 4. Summary of acoustic bat data and weather during each survey night at the Record Hill Turbine 22 detector – 2012

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	**Operational?**	**BBSH**	**Big brown**	**Silver-haired**	**Hoary**	**MYSP**	**Eastern red**	**Tri-colored**	**RBTB**	**HFUN**	**LFUN**	**UNKN**	**Total**	**Wind Speed (m/s)**	**Temperature (celsius)**
04/18/12	1												**0**	3.5	6.5
04/19/12	1				1						1		**2**	3.7	8.9
04/20/12	1												**0**	6.5	12.8
04/21/12	1												**0**	5.6	5.8
04/22/12	1												**0**	10.1	0.8
04/23/12	1												**0**	6.9	7.3
04/24/12	1												**0**	6.3	4.1
04/25/12	1												**0**	5.7	2.5
04/26/12	1												**0**	4.9	4.1
04/27/12	1												**0**	16.6	-3.7
04/28/12	1												**0**	7.1	-0.8
04/29/12	1												**0**	9.8	0.5
04/30/12	1												**0**	3.3	5.7
05/01/12	0												**0**	3.5	1.7
05/02/12	0												**0**	2.8	4.1
05/03/12	0												**0**	2.2	6.5
05/04/12	0												**0**	2.8	7.0
05/05/12	0												**0**	3.8	7.8
05/06/12	0												**0**	2.3	9.0
05/07/12	0												**0**	4.6	10.4
05/08/12	0												**0**	2.1	4.5
05/09/12	0												**0**	3.6	10.6
05/10/12	0												**0**	9.0	5.3
05/11/12	1												**0**	5.6	7.4
05/12/12	1				1						2		**3**	4.7	13.5
05/13/12	1				1					1			**2**	2.1	12.0
05/14/12	1												**0**	4.2	12.1
05/15/12	1												**0**	3.0	11.8
05/16/12	1												**0**	7.2	11.1
05/17/12	1												**0**	6.3	7.7
05/18/12	1	3								1	2		**6**	2.7	13.5
05/19/12	1	2			1						5		**8**	3.3	18.2
05/20/12	1				1						1		**2**	5.0	18.3
05/21/12	1												**0**	3.2	13.7
05/22/12	1												**0**	2.3	14.4
05/23/12	1	1			5						3		**9**	4.2	16.1
05/24/12	0										1		**1**	3.9	13.1
05/25/12	0												**0**	5.8	14.7
05/26/12	0												**0**	3.1	14.5
05/27/12	0												**0**	3.5	12.8
05/28/12	0												**0**	4.1	11.1
05/29/12	0												**0**	3.3	12.0
05/30/12	0												**0**	3.6	14.0
05/31/12	0												**0**	4.5	10.0
06/01/12	0												**0**	3.9	12.4
06/02/12	0												**0**	10.3	7.6
06/03/12	0												**0**	10.3	7.4
06/04/12	1												**0**	3.5	7.5
06/05/12	1	1			2					5	4		**12**	3.4	9.4
06/06/12	1				4						1		**5**	1.6	10.1
06/07/12	1				1								**1**	3.3	10.1
06/08/12	1	1			1								**2**	5.7	10.7
06/09/12	1				1								**1**	4.8	14.2
06/10/12	1				3						3		**6**	4.3	13.7
06/11/12	1				8						8		**16**	2.8	13.7
06/12/12	1				2						6		**8**	6.9	15.2
06/13/12	1				4						2		**6**	4.5	13.1
06/14/12	1	1			325						78		**404**	4.1	14.1
06/15/12	1	4		2	45						6		**57**	2.6	14.9
06/16/12	1				9						3		**12**	4.0	11.9
06/17/12	1	1			7						4		**12**	3.7	9.7
06/18/12	1				1						1		**2**	3.1	11.1
06/19/12	1										2		**2**	6.1	19.4
06/20/12	1										1		**1**	7.1	22.9
06/21/12	1	1	1	1	4						1		**8**	3.9	23.1
06/22/12	1				1						1		**2**	3.9	19.5
06/23/12	1												**0**	5.1	14.4
06/24/12	1			1	1						5		**7**	4.1	16.5
06/25/12	1				30						6		**36**	2.0	12.8
06/26/12	1												**0**	8.5	12.2
06/27/12	1												**0**	7.0	13.7
06/28/12	1				1						1		**2**	3.7	16.7
06/29/12	1										1		**1**	8.3	21.0
06/30/12	1				2						2		**4**	ND	ND
07/01/12	1			1	5								**6**	ND	ND
07/02/12	1												**0**	4.2	15.0
07/03/12	1				1								**1**	3.4	17.5
07/04/12	1										3		**3**	4.8	16.6
07/05/12	1				2						1		**3**	3.7	17.8
07/06/12	1			1							2		**3**	5.9	20.9
07/07/12	1			1	3					1	1		**6**	5.4	17.6
07/08/12	1				1								**1**	5.9	13.7
07/09/12	1										1		**1**	5.8	14.0
07/10/12	1	1		1			1			1	2		**6**	4.0	16.4
07/11/12	1									1			**1**	3.5	18.4
07/12/12	1				1					1	1		**3**	3.4	20.6
07/13/12	1										3		**3**	3.8	21.7
07/14/12	1										3		**3**	3.5	23.3
07/15/12	1	1		1	4		3			15	2		**26**	3.1	20.0
07/16/12	1				1						1		**2**	2.9	19.8
07/17/12	1												**0**	8.7	20.2
07/18/12	1												**0**	5.8	13.5
07/19/12	1	1					1						**2**	5.1	12.5
07/20/12	1	1		2	1	1				1			**6**	2.7	16.8
07/21/12	1	1					1						**2**	4.4	17.3
07/22/12	1	1											**1**	3.5	20.7

cont.

Appendix C Table 4 *cont.*

		BBSH			HB	MYSP	RBTB			UNKN					
Night of	**Operational?**	**BBSH**	**Big brown**	**Silver-haired**	**Hoary**	**MYSP**	**Eastern red**	**Tri-colored**	**RBTB**	**HFUN**	**LFUN**	**UNKN**	**Total**	**Wind Speed (m/s)**	**Temperature (celsius)**
07/23/12	0												**0**	5.5	17.8
07/24/12	0												**0**	7.7	13.9
07/25/12	0												**0**	4.0	15.3
07/26/12	0												**0**	2.4	15.2
07/27/12	0												**0**	2.7	19.3
07/28/12	0												**0**	2.2	17.1
07/29/12	0												**0**	3.0	15.8
07/30/12	0												**0**	2.9	19.0
07/31/12	0												**0**	2.9	15.8
08/01/12	0												**0**	1.5	17.9
08/02/12	0												**0**	3.2	20.3
08/03/12	0												**0**	4.5	19.9
08/04/12	0												**0**	4.0	20.5
08/05/12	0												**0**	8.1	18.8
08/06/12	0												**0**	4.0	13.9
08/07/12	1			3					1	3	3		**10**	3.8	17.8
08/08/12	1	2		2	1						1		**6**	2.7	20.6
08/09/12	1									6	1		**7**	3.6	17.3
08/10/12	1					1				6			**7**	5.7	17.4
08/11/12	1						1	1		9			**11**	3.6	17.6
08/12/12	1	2		2					1	1	3		**9**	2.7	17.4
08/13/12	1	2		4				1		4	3		**14**	3.9	17.8
08/14/12	1	34		51	1	1			1	1	73		**162**	2.3	18.8
08/15/12	1	158		225					2	14	91		**490**	1.8	17.4
08/16/12	1	40		43	1						41		**125**	4.9	15.1
08/17/12	1	19		16						1	26		**62**	5.3	16.7
08/18/12	1	12		5		1				1	28		**47**	6.2	13.6
08/19/12	1	35		8						2	62		**107**	1.9	15.2
08/20/12	1												**0**	3.9	15.9
08/21/12	1	3		18						4	5		**30**	2.6	14.8
08/22/12	1	2		1				1		2	1		**7**	3.7	16.5
08/23/12	1			1							2		**3**	3.5	16.2
08/24/12	1	15		8					1	3	9		**36**	2.4	17.9
08/25/12	1	1		1						1			**3**	4.5	16.9
08/26/12	1	2	1	13	1				10	4	4		**35**	3.3	18.7
08/27/12	1	4		1									**5**	4.6	18.0
08/28/12	1	1								1	1		**3**	9.2	11.6
08/29/12	1												**0**	8.0	13.6
08/30/12	1												**0**	12.0	19.1
08/31/12	1	3				1				5	2		**11**	4.0	16.6
09/01/12	1	6		3					1	1	3		**14**	3.3	14.9
09/02/12	1	2		6						1	1		**10**	2.1	13.0
09/03/12	1	1		3						1	1		**6**	3.0	14.4
09/04/12	1								1				**1**	3.2	14.7
09/05/12	1												**0**	1.7	15.4
09/06/12	1												**0**	3.8	17.3
09/07/12	1												**0**	3.5	18.4
09/08/12	1												**0**	9.4	13.8
09/09/12	1												**0**	6.2	9.8
09/10/12	1			1									**1**	8.4	8.5
09/11/12	1												**0**	3.9	11.8
09/12/12	1												**0**	5.3	15.6
09/13/12	1												**0**	3.2	17.5
09/14/12	1			1						2			**3**	3.8	15.6
09/15/12	1			1									**1**	9.8	6.6
09/16/12	1				1								**1**	6.0	7.1
09/17/12	1								1				**1**	3.3	12.8
09/18/12	1												**0**	9.3	15.9
09/19/12	1												**0**	4.0	5.7
09/20/12	1									3			**3**	4.2	8.2
09/21/12	1									2	1		**3**	2.5	9.2
09/22/12	1									1	1		**2**	4.8	13.3
09/23/12	1												**0**	4.1	6.5
09/24/12	1												**0**	4.0	7.4
09/25/12	1												**0**	4.6	11.4
09/26/12	1								1	2			**3**	5.7	10.0
09/27/12	1												**0**	3.3	5.0
09/28/12	1												**0**	4.2	6.7
09/29/12	1												**0**	4.6	9.3
09/30/12	1												**0**	5.5	9.1
10/01/12	1												**0**	9.0	10.8
10/02/12	1								1	3	1		**5**	2.6	13.8
10/03/12	1									2			**2**	2.8	12.8
10/04/12	1												**0**	3.5	11.9
10/05/12	1												**0**	4.2	15.2
10/06/12	1												**0**	10.1	5.9
10/07/12	1												**0**	4.1	3.3
10/08/12	1												**0**	2.3	4.2
10/09/12	1												**0**	2.9	5.5
10/10/12	1												**0**	10.0	5.4
10/11/12	1												**0**	7.0	4.2
10/12/12	1												**0**	10.0	-1.8
10/13/12	1												**0**	5.1	1.6
10/14/12	1												**0**	3.6	6.4
10/15/12	1									16			**16**	4.8	11.3
10/16/12	1												**0**	9.7	2.1
10/17/12	1												**0**	2.8	8.8
10/18/12	1												**0**	3.8	7.4
10/19/12	1								1				**1**	6.1	13.0
10/20/12	1												**0**	6.3	9.4
10/21/12	1												**0**	14.0	6.5
10/22/12	1												**0**	11.3	5.8
10/23/12	1												**0**	5.1	3.1
By Species		**365**	**2**	**428**	**486**	**5**	**7**	**3**	**22**	**129**	**535**	**0**	**1982**		
By Guild		**795**			**486**	**5**	**32**			**664**					
		BBSH			**HB**	**MYSP**	**RBTB**			**UNKN**			**Total**		

Appendix D

Eagle and Raptor Survey Result Tables

Appendix D Table 1. Daily total observations of raptor species and daily passage rates at the Record Hill Wind Project, Spring 2012

Species	3/20/2012	3/21/2012	3/27/2012	4/19/2012	4/26/2012	5/3/2012	5/7/2012	5/8/2012	5/17/2012	5/18/2012	Entire Season
bald eagle		2									**2**
broad-winged hawk							3		1	1	**5**
red-shouldered hawk				1							**1**
sharp-shinned hawk									1		**1**
turkey vulture				3	11		9			3	**26**
unidentified buteo hawk							1				**1**
Totals	**0**	**2**	**0**	**4**	**11**	**0**	**13**	**0**	**2**	**4**	**36**

Appendix D Table 2. Daily total observations of raptor species and daily passage rates at the Record Hill Wind Project, Fall 2012

Species	9/6/2012	9/7/2012	9/11/2012	9/12/2012	9/20/2012	9/24/2012	9/25/2012	10/5/2012	10/9/2012	10/10/2012	10/24/2012	10/25/2012	11/6/2012	Entire Season
American kestrel	1				1				1					**3**
bald eagle	1					1	1							**3**
broad-winged hawk	11		4	1		1								**17**
Cooper's hawk						1		1						**2**
merlin									1					**1**
osprey	1													**1**
red-shouldered hawk	1													**1**
red-tailed hawk	4	1	1	1	1				1	3	1		1	**14**
sharp-shinned hawk	4		1	1										**6**
turkey vulture	4	4	7	8	2	3	3	3	1	1				**36**
unidentified accipiter hawk												1		**1**
unidentified buteo hawk					1			1			1	2		**5**
unidentified eagle				1										**1**
unidentified falcon													1	**1**
unidentified hawk	1		4	2		1	1	1	1		1	2		**14**
Daily Totals	**28**	**5**	**17**	**14**	**5**	**7**	**5**	**6**	**5**	**4**	**3**	**5**	**2**	**106**

Appendix D Table 3. Hourly summary of raptor observations at Record Hill Wind Project, Spring 2012.

Species	9:00-10:00	10:00-11:00	11:00-12:00	12:00-1:00	1:00-2:00	2:00-3:00	3:00-4:00	4:00-5:00	Grand Total
bald eagle	1		1						**2**
broad-winged hawk		1			1		2	1	**5**
red-shouldered hawk					1				**1**
sharp-shinned hawk			1						**1**
turkey vulture	1			1	9	4	11		**26**
unidentified buteo hawk	1								**1**
Hourly totals	**3**	**1**	**2**	**1**	**11**	**4**	**13**	**1**	**36**

Appendix D Table 4. Hourly summary of raptor observations at the Record Hill Wind Project, Fall 2012

Species	9:00-10:00	10:00-11:00	11:00-12:00	12:00-1:00	1:00-2:00	2:00-3:00	3:00-4:00	4:00-5:00	Grand Total
American kestrel	1			1			1		3
bald eagle				1	1	1			3
broad-winged hawk		4	10			2	1		17
Cooper's hawk			1	1					2
merlin	1								1
osprey						1			1
red-shouldered hawk		1							1
red-tailed hawk		3	5	1	1	2	2		14
sharp-shinned hawk	1		4			1			6
turkey vulture		6	7	4	10	4	5		36
unidentified accipiter hawk		1							1
unidentified buteo hawk		1		2			2		5
unidentified eagle		1							1
unidentified falcon						1			1
unidentified hawk		2	3	2	2	1	4		14
Hourly totals	**3**	**19**	**30**	**12**	**14**	**13**	**15**	**0**	**106**

Appendix D Table 5. Number of individuals of species observed in areas of turbine areas above or below 126.5 m, Record Hill Wind Project, Spring 2012.

Species	126.5 m or greater	less than 126.5 m	outside project area
bald eagle			2
broad-winged hawk		3	2
red-shouldered hawk	1		
sharp-shinned hawk		1	
turkey vulture	2	6	18
unidentified buteo hawk			1
All Species	**3**	**10**	**23**
	8%	28%	64%

Appendix D Table 6. Number of individuals of species observed within Project area (proposed turbine areas) above or below 126.5 m, Record Hill Wind Project, Fall 2012

Species	126.5 m or greater	less than 126.5 m	outside project area
American kestrel	1	1	1
bald eagle	2	1	
broad-winged hawk	8	6	3
Cooper's hawk	1	1	
merlin		1	
osprey		1	
red-shouldered hawk		1	
red-tailed hawk	1	10	3
sharp-shinned hawk	4	1	1
turkey vulture	4	13	19
unidentified accipiter hawk		1	
unidentified buteo hawk		2	3
unidentified eagle			1
unidentified falcon		1	
unidentified hawk	1	3	10
TOTAL	**22**	**43**	**41**
	21%	41%	39%

Appendix D Table 7. Closest turbine to raptor observations at the Record Hill Wind Project, Spring 2012

Species	1	8	9	10	11	12	14	15	17	18	19	22	TOTAL
bald eagle		1										1	2
broad-winged hawk				1	2			1	1				5
red-shouldered hawk					1								1
sharp-shinned hawk						1							1
turkey vulture	4	1	2		4		2		2	2	7	2	26
unidentified buteo hawk				1									1
TOTAL	**4**	**2**	**2**	**2**	**7**	**1**	**2**	**1**	**3**	**2**	**7**	**3**	**36**

Appendix D Table 8. Distance of raptor observations to closest turbine (in m) at the Record Hill Wind Project, Spring 2012

Species	50	75	100	150	300	1000	>1000	N/A	TOTAL
bald eagle						1	1		**2**
broad-winged hawk	1							4	**5**
red-shouldered hawk			1						**1**
sharp-shinned hawk				1					**1**
turkey vulture	1	2	2		3			18	**26**
unidentified buteo hawk								1	**1**
TOTAL	**2**	**2**	**3**	**1**	**3**	**1**	**1**	**23**	**36**

Appendix D Table 9. Closest turbine to raptor observations at the Record Hill Wind Project, Fall 2012

Species	1	8	9	10	10, 11	11	12	13	13, 14	14	14, 15	15	16	17	18	21	22	na	TOTAL
American kestrel				1		1											1		**3**
bald eagle	2						1												**3**
broad-winged hawk					1		10	4				2							**17**
Cooper's hawk							2												**2**
merlin						1													**1**
osprey							1												**1**
red-shouldered hawk							1												**1**
red-tailed hawk			1	2		2	7										1	1	**14**
sharp-shinned hawk						1	4										1		**6**
turkey vulture	13			1	1	2	6	3		2	1	1	2					4	**36**
unidentified accipiter hawk								1											**1**
unidentified buteo hawk										1		1	1					2	**5**
unidentified eagle																1			**1**
unidentified falcon								1											**1**
unidentified hawk	1	1							1	1			1	1	1		2	5	**14**
TOTAL	**16**	**1**	**1**	**4**	**2**	**7**	**32**	**9**	**1**	**4**	**1**	**4**	**4**	**1**	**1**	**1**	**5**	**12**	**106**

Appendix D Table 10. Distance of raptor observations to closest turbine (in m) at the Record Hill Wind Project, Fall								
Species	**< 50**	**50-100**	**101-150**	**151-200**	**201-250**	**> 250**	**na**	**TOTAL**
American kestrel		1			1	1		**3**
bald eagle		2				1		**3**
broad-winged hawk		7		4	1	5		**17**
Cooper's hawk		1	1					**2**
merlin		1						**1**
osprey		1						**1**
red-shouldered hawk	1							**1**
red-tailed hawk	1	9		1		2	1	**14**
sharp-shinned hawk	1			2		3		**6**
turkey vulture	2	11	2		1	16	4	**36**
unidentified accipiter hawk		1						**1**
unidentified buteo hawk			1	2			2	**5**
unidentified eagle						1		**1**
unidentified falcon		1						**1**
unidentified hawk		2	1		1	4	6	**14**
TOTAL	**5**	**37**	**5**	**9**	**4**	**33**	**13**	**106**

Appendix D Table 11. Incidental raptor observations documented during 2012 on-site field surveys at the Record Hill Wind Project.

Date	Time	Species	# of individuals	Age	If flying, minimum flight height above ground (m)	If flying, maximum flight height above ground (m)	Behavior	Behavior Modification or Avoidance?	Habitat near observation	In Turbine Area?	# closest turbine(s)	Distance to closest turbine (m)	Was turbine spinning? (y/n)
5/6/2012	7:58	bald eagle	1	adult	10	10	flying over Roxbury Pond	N	pond	N	na	na	na
5/22/2012	8:50	barred owl	1	na	na	na	calling near 22	N	forest	Y	22	200	y
4/16/2004	10:30	broad-winged hawk	1	na	30	30	flew between turbines 7 & 8	N	gravel pad/forest	Y	7, 8	20	y
5/31/2012	14:48	broad-winged hawk	1	na	15	15	soaring near 21	N	forest	Y	21	100	na
7/14/2012	10:10	broad-winged hawk	1	adult	10	30	flew low into turbine area	N	forest	Y	22	10	y
8/23/2012	6:50	broad-winged hawk	1	adult	na	na	flying over slope in vicinity of turbines	N	forest/road	N	12	75	y
7/14/2012	17:50	red-tailed hawk	1	adult	0	10	on ground on turbine pad	N	gravel pad/forest	Y	7	20	y
7/15/2012	11:45	red-tailed hawk	1	adult	60	60	weaving in and out of turbine area	N	forest	Y	8, 9, 10, 11	10	y
8/30/2012	19:00	red-tailed hawk	1	adult	15	15	none; viewed at gate entrance	N	forest	N	19	2000	y
5/7/2012	8:20	rough-legged hawk	1	mature	50	50	flying around turbines	N	gravel pad/forest	Y	3, 4	10	n
8/22/2012	12:25	sharp-shinned hawk	1	adult	2	2	flying low near turbine pad	N	forest	Y	1	75	y
4/16/2004	9:45	turkey vulture	4	na	40	60	flew between turbines	N	forest	Y	5	50	n
4/29/2010	16:50	turkey vulture	1	na	45	45	flew between turbines	N	forest	Y	7	100	y
8/22/2012	10:35	turkey vulture	1	adult	30	30	east of project	N	forest	N	6, 7	200	y
5/10/2012	6:03	turkey vulture	2	adult	70	70	along west side of ridge	N	forest	N	16	500	y
5/12/2012	16:30	turkey vulture	3	adult	70	70	away from ridge	N	forest	N	19	na	na
9/29/2012	13:42	turkey vulture	1	adult	7	20	flew into site beneath blades	N	forest	Y	11	3	y
8/31/2012	8:30	unidentified accipiter	1	adult	15	15	weaving in and out of turbine area	N	forest/ridge	Y	22	70	y
6/6/2012	13:35	unidentified accipiter	1	adult	40	40	flew quite close to turbines	N	forest	Y	21, 22	40	y
9/29/2012	14:40	unidentified accipiter	1	adult	7	10	in woods on turbine pad edge	N	forest	Y	10	60	y
5/24/2012	13:00	unidentified large raptor	1	adult	20	20	flew close to ground near turbines	N	forest	Y	21, 22	75	y
7/15/2012	11:15	unidentified large raptor	1	adult	80	200	soaring above turbines	N	forest	Y	2	20	y

Appendix D Table 12. Non-raptor avian species observed incidentally during raptor surveys at the Record Hill Wind Project, 2012

Common name	Scientific name
American crow	*Corvus brachyrhynchos*
American goldfinch	*Spinus tristis*
American robin	*Turdus migratorius*
black-and-white warbler	*Mniotilta varia*
blackburnian warbler	*Setophaga fusca*
black-capped chickadee	*Poecile atricapillus*
black-throated blue warbler	*Setophaga caerulescens*
black-throated green warbler	*Setophaga virens*
blue jay	*Cyanocitta cristata*
Canada goose	*Branta canadensis*
cedar waxwing	*Bombycilla cedrorum*
chestnut-sided warbler	*Setophaga pensylvanica*
common raven	*Corvus corax*
common yellowthroat	*Geothlypis trichas*
dark-eyed junco	*Junco hyemalis*
downy woodpecker	*Picoides pubescens*
golden-crowned kinglet	*Regulus satrapa*
hermit thrush	*Catharus guttatus*
least flycatcher	*Empidonax minimus*
magnolia warbler	*Setophaga magnolia*
mourning warbler	*Geothlypis philadelphia*
Nashville warbler	*Oreothlypis ruficapilla*
northern flicker	*Colaptes auratus*
ovenbird	*Seiurus aurocapilla*
pileated woodpecker	*Dryocopus pileatus*
red-breasted nuthatch	*Sitta canadensis*
red-eyed vireo	*Vireo olivaceus*
rose-breasted grosbeak	*Pheucticus ludovicianus*
ruffed grouse	*Bonasa umbellus*
scarlet tanager	*Piranga olivacea*
snow bunting	*Plectrophenax nivalis*
unidentified bird	*Aves (gen, sp)*
unidentified nuthatch	*Sitta (sp)*
white-breasted nuthatch	*Sitta carolinensis*
white-throated sparrow	*Zonotrichia albicollis*
white-winged crossbill	*Loxia leucoptera*
winter wren	*Troglodytes hiemalis*
yellow-rumped warbler	*Setophaga coronata*

Appendix D Table 13. Available raptor and owl mortality data reported at wind farms in the U.S. (outside of California) from 1994-2012

Location	Habitat Type (# Turbines)	Year	Study period	Search Interval	Number of fatalities and species	Dates of carcass discovery	Reference
Buffalo Ridge, MN	agricultural grassland (73)	1995	April 1994 - Dec 1995	30-50 weekly	0	n/a	Osborn, R.G., K.F. Higgins, R.E. Usgaard, C.D. Dieter, and R.D. Neiger. 2000. Bird mortality associated with wind turbines at the Buffalo Ridge Wind Resource Area, Manitoba. Am. Midle. Nat. 143: 41-52.
Searsburg, VT	forested ridge (11)	1997	1997	11 total (4 per search) 2-6 days per month	0	n/a	Kerlinger, P. 2002. An Assessment of the Impacts of Green Mountain Power Corporation's Wind Power Facility on Breeding and Migrating Birds in Searsburg, Vermont. Prepared for the Vermont Department of Public Service Montpelier, Vermont. Subcontractor report for the National Renewable Energy Laboratory NREL/SR-500-28591.
Buffalo Ridge, MN	agricultural grassland (138)	1999	1996-1999	30 per 14 days	1 red-tailed hawk	n/a	Johnson, G., W. Erickson, M. Strickland, M. Shepherd, S. Sarappo. 2002. Collision mortality of local and migrant birds at a large-scale wind-power development on Buffalo Ridge, Minnesota. Wildlife Society Bulletin 20: 879-887.
Vansycle, OR	agricultural grassland (38)	1999	1999	All turbines searched each 28-day period	0	n/a	Erickson W. P., G. D. Johnson, M. D. Strickland, and K. Kronner. 2000. Avian and bat mortality associated with the Vansycle wind project, Umatilla County, Oregon,1999 study year. Pendleton, OR: Technical report prepared for Umatilla County Department of Resource Services and Development.
Somerset County, PA	agricultural grassland (8)	2000	2000	n/a	0	n/a	Kerlinger, P. 2006. Supplement to the Phase I Avian Risk Assessment and Breeding Bird Study for the Deerfield Wind Project, Bennington County, Vermont. Prepared for Deerfield Wind, LLC.
Kewaunee County, WI	agricultural grassland (31)	2001	1999-2001		0	n/a	Howe, R.W., W. Evans, and A.T. Wolf. 2002. Effects of wind turbines on birds and bats in northeastern Wisconsin. Report to Wisconsin Public Service Corporation and Madison Gas and Electric Company, Madison, WI.
Foote Creek Rim, WY	shrub-steppe grassland (69)	2002	1998-2002	35 searched once every 2 weeks	1 northern harrier, 3 American kestrel, 1 short-eared owl	Northern harrier (4/19/99); American kestrel (5/12/99, 10/12/99, 7/19/00); short-eared owl (09/28/00)	Young, D.P., W.P. Erickson, R.E. Good, M.D. Stickland, G.D. Johnson. 2003. Avian and bat mortality associated with the initial phase of the Foote Creek Rim Windpower Project, Carbon County, Wyoming. Prepared for Pacificorp, Inc.
Klondike, OR	shrub-steppe grassland (16)	2003	2002-2003	1 x month	0	n/a	Johnson, G. D., W. P. Erickson, M. D. Strickland, M. F. Shepherd, D. A. Shepherd, and S. A. Sarappo. 2003. Mortality of bats at a large-scale wind power development at Buffalo Ridge, Minnesota. American Midland Naturalist 150:332-342.
Mountaineer, WV	forested ridge (44)	2003	2003	2 x per week	1 red-tailed hawk, 2 turkey vultures	each between 04/04/03 - 04/27/03, 06/02/03 -06/24/03, 07/28/03 - 07/29/03, and 08/18/03 - 11/22/03	Kerns, J., and P. Kerlinger. 2004. A study of bird and bat collision fatalities at the Mountaineer Wind Energy Center, Tucker County, West Virginia, USA: annual report for 2003. http://www.responsiblewind.org/docs/MountaineerFinalAvianRpt3-15-04PKJK.pdf. Accessed 30 September 2007.
Nine Canyon, WA	shrub-steppe grassland (37)	2003	2002-2003	1 x 2 weeks	1 American kestrel, 1 short-eared owl	American kestrel (11/18/02), short eared owl (4/7/03)	Erickson, W.P., K. Kronner, and B. Gritski. 2003. Nine Canyon Wind power project avian and bat monitoring report. Prepared for Nine Canyon Technical Advisory Committee Energy Northwest. Western Ecosystems Technology, Cheyenne, Wyoming. Http://www.west-inc.com/reports/nine_canyon_monitoring_final.pdf.
Stateline, WA/OR	agricultural grassland (454)	2003	2001-2003	120-150 total	9 red-tailed hawk, 3 American kestrel, 1 ferruginous hawk, 1 Sawinson's hawk, 1 short-eared owl	n/a	Erickson, W.P., J. Jeffrey, K. Kronner, and K. Bay. 2004. Stateline Wind Project Wildlife Monitoring Final Report, July 2001 – December 2003. Technical report peer-reviewed by and submitted to FPL Energy, the Oregon Energy Facility Siting Council, and the Stateline Technical Advisory Committee.
Top of Iowa, IA	agricultural (89)	2003	April 15 - December 15, 2003	26 every 2-3 days	0	n/a	Koford, R., A. Jain, G. Zenner, and A. Hancock. 2004. Avian Mortality Associated with the Top of Iowa Wind Farm Progress Report Calendar Year 2003.
Meyersdale, PA	forested ridgeline (20)	2004	2 August - 13 September, 2004	10 daily, 10 weekly	0	n/a	Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn. 2005. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. Prepared for Bats and Wind Energy Cooperative.
Mountaineer, WV	forested ridge (44)	2004	2004	22 daily, 22 weekly	1 sharp-shinned hawk, 1 turkey vulture	both between 07/31/04 - 09/11/04	Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn. 2005. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. Prepared for Bats and Wind Energy Cooperative.
Mountaineer, WV	forested ridge (44)	2004	etween 7/31/04 - 9/11/0	22 daily, 22 weekly	1 sharp-shinned hawk, 1 turkey vulture	between 7/31/04-9/11/04	Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn. 2005. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. Prepared for Bats and Wind Energy Cooperative.
Top of Iowa, IA	agricultural grassland (89)	2004	2004	26 every 3 days	1 red-tailed hawk	4/01/04 - 12/10/04	Koford, R., A. Jain, G. Zenner, and A. Hancock. 2005. Avian Mortality Associated with the Top of Iowa Wind Farm Progress Report 2004 February 2, 2005.
Meyersdale, PA	forested ridgeline (20)	2004	2004	10 daily, 10 weekly	0	n/a	Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn. 2005. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. Prepared for Bats and Wind Energy Cooperative.
Buffalo Mountain, TN	open/shrubland (18)	2005	2005	18 of 18 every week, every 2 weeks, or every 2-5 days	0	n/a	Fiedler, J.K., T.H. Henry, R.D. Tankersley, and C.P. Nicholson 2007. Results of Bat and Bird Mortality Monitoring at the Expanded Buffalo Mountain Windfarm, 2005 June 28, 2007. Prepared for Tennessee Valley Authority.
Oklahoma, OK	agricultural, wooded riparian (68)	2005	May - July, 2004 - 2005	68 twice in 2004 and four times in 2005 (1 search in late may, 1 in late june, once every 15 days between May 15 and July 15)	1 turkey vulture	summer 2005	Piorkowski, M. D. 2006. Breeding bird habitat use and turbine collisions of birds and bats located at a wind farm in Oklahoma mixed-grass prairie. Master's Thesis, Oklahoma State University, Stillwater, OK
Maple Ridge, NY	woodland, agricultural grassland (120)	2006	2006	10 every 3 days, 30 7 days, 10 daily	1 American kestrel	7/6/2006	Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2007. Annual Report for the Maple Ridge Wind Power Project Postconstruction Bird and Bat Fatality Study – 2006 FINAL REPORT June 25, 2007. Prepared for PPM Energy and Horizon Energy and Technical Advisory Committee (TAC for the Maple Ridge Project Study).
Massachusetts Maritime Academy Turbine, Massachusetts	coastal (1)	2006	24 April - 30 November, 2006	4-12 searches/week	1 osprey	n/a	Vletstra, L. 2008. Common and Roseate Tern Exposure to the Massachusetts Maritime Academy Wind Turbine: 2006 and 2007.
NPPD Ainsworth, NE	sandhills grassland/pastoral (36)	2007	3/13 - 11/4/2007	36 once every 14 days	2 American kestrel, 1 short-eared owl	3/1 -3/8/07	Derby, C., A. Dahl, W. Erickson, K. Bay and J. Hoban. 2007. Post-construction Monitoring Report for Avian and Bat Mortality at the NPPD Ainsworth Wind Far. Prepared for Nebraska Public Power District, Columbus, NE.
Maple Ridge, NY	woodland, agricultural grassland (195)	2007	2007	64 weekly	1 American kestrel, 5 red-tailed hawk	red-tailed hawk (1 found 8/07, 2 found 9/07) // (1 sharp-shinned hawk and 2 red-tailed hawk dates not reported)	Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2008. Annual Report for the Maple Ridge Wind Power Project Postconstruction Bird and Bat Fatality Study – 2007 (May 2, 2008). Prepared for PPM Energy and Horizon Energy and Technical Advisory Committee (TAC for the Maple Ridge Project Study).
Mars Hill, ME	forested ridgeline (28)	2007	2007	2 of 28 daily, 28 of 28 weekly, seasonal dog searches	0	n/a	Stantec Consulting. 2008. Spring, Summer, and Fall Post-construction Bird and Bat Mortality Study at the Mars Hill Wind Farm, Maine. Unpublished report prepared for UPC Wind Management, LLC.
Massachusetts Maritime Academy Turbine, Massachusetts	coastal (1)	2007	15 April - 30 November, 2007	3-5 searches/week	0	n/a	Vletstra, L. 2008. Common and Roseate Tern Exposure to the Massachusetts Maritime Academy Wind Turbine: 2006 and 2007.
Red Canyon, TX	cattle range, shrub stands, grasses (56)	2007	Sept 2006 - Aug 2007	28 turbines once a week	11 turkey vulture, 1 great horned owl, 1 barn owl, 1 red-tailed hawk	n/a	Miller, A. 2008. Patterns of Avian and Bat Mortality at a Utility-Scaled Wind Farm on the Southern High Plains. Submitted to Texas Tech University in partial fulfillment of a Masters Degree.
Mount Storm	WV	2008	9/25/08	search	turkey vulture	raptor	Young, D.P., S. Nomani, W. Tidhar, and K. Bay. 2010. Mount Storm Wind Energy Facility Post-construction Avian and Bat Monitoring, July-October 2010. Prepared for NedPower Mount Storm, LLC.
Bliss NY	agricultural, woodland (67)	2008	April 21 - Nov 14, 2008	8 daily, 8 every 3-days, 7 every 7-days	3 red-tailed hawk, 1 sharp-shinned hawk	n/a	Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, J. Quant, D. Pursell. 2009d. Annual Report for the Noble Bliss Windpark, LLC. Postconstruction Bird and Bat Fatality Study – 2008. Prepared by Curry and Kerlinger, LLC.
Casselman, PA	forested ridge, agricultural, reclaimed mine (23)	2008	April 19 - Nov 15, 2008	10 daily	0	n/a	Arnett, E.B., M. Schirmacher, M. M. P. Huso, and J. P. Hayes. 2009. Effectiveness of Changing Wind Turbine Cut-in Speed to Reduce Bat Fatalities at Wind Facilities, 2008 Annual Report. Prepared for the Bats and Wind Energy Cooperative and the Pennsylvania Game Commission.
Clinton, NY	agricultural, woodland (67)	2008	2008	8 daily, 8 every 3-days, 7 every 7-days	1 broad-winged hawk	May	Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, J. Histed, and J. Meacham. 2009b. Annual Report for the Noble Clinton Windpark, LLC. Postconstruction Bird and Bat Fatality Study – 2008. Prepared by Curry and Kerlinger, LLC.
Ellenburg, NY	agricultural, woodland (54)	2008	2008	6 daily, 6 every 3-days, 6 every 7-days	1 broad-winged hawk	June	Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, A. Fuerst, and C. Hansen. 2009. Annual Report for the Noble Ellenburg Windpark, LLC. Postconstruction Bird and Bat Fatality Study – 2008. Prepared by Curry and Kerlinger, LLC.
Maple Ridge, NY	woodland, grassland, agricultural (195)	2008	2008	64 weekly	1 American kestrel, 2 sharp-shinned hawk, 1 Cooper's hawk	n/a	Jain, A., and P. Kerlinger, R. Curry, L. Slobodnik, and M. Lehman. 2009a. Annual Report for the Maple Ridge Wind Power Project Postconstruction Bird and Bat Fatality Study – 2008 (May 14, 2009).
Mars Hill, ME	forested ridgeline (28)	2008	2008	28 of 28 weekly, seasonal dog searches	1 barred owl	4/11/2008	Stantec Consulting. 2009. Post-construction Monitoring at the Mars Hill Wind Farm, Maine – Year 2. Unpublished report prepared for First Wind Management, LLC.
Mount Storm, WV	forested ridgeline (82)	2008	2008	18 weekly, 9 daily	2 turkey vulture	9/25/2008 and 10/13/2008	Young *et al*. 2009
Munnsville, NY	agricultural (23)	2008	2008	12 weely	2 red-tailed hawk	7/16 and 8/14	Stantec Consulting. 2009c. Post-construction monitoring at the Munnsville Wind Farm, New York, 2008. Prepared for E.ON Climate and Renewables.
Blue Sky Green Field, WI	agricultural (88)	2009	7/21 - 10/3/2008; 3/17 - 6/4/2009	10 daily, 20 every 4-6 days	1 red-tailed hawk	2009	Gruver, J.C., M. Sonnenberg, K. Bay, and W.P. Erickson. 2009. Results of a Post-Construction Bat and Bird Fatality Study at Blue Sky Green Field Wind Energy Center, Fond du Lac County, Wisconsin, July 2008-May 2009. Final report prepared for We Energies, Milwaukee, WI. Prepared by Western EcoSystems Technology, Inc., Cheyenne, Wyoming.
Cohocton and Dutch Hill, NY	agricultural (50)	2009	2009	5 daily, 12 weekly	1 sharp-shinned hawk	7/8/2009	Stantec Consulting. 2010. Cohocton and Dutch Hill Wind FarmsYear 1 Post-Construction Monitoring Report, 2009 for the Cohocton and Dutch Hill Wind Farms In Cohocton, New York. Prepared for Canandaigua Power Partners, LLC and Canandaigua Power Partners II, LLC.
Forward, WI	97% agricultural, 2% decidious woodlands (86)	2009	7/15 - 11/15/2008; 4/15 - 5/31/2009, 7/15 - 11/15/2009	1, 3, or 5 days	1 red tailed hawk	fall 2008	Drake, D., J. Garvin, S. Grodsky, and M. Watt. 2010. Post-construction Bird and Bat Monitoring at the Forward Energy Center. Prepared for Forward Energy LLC.
Jersey Atlantic, NJ	wetland/wastewater treatment (5)	2009	1/1 - 8/31/2009	3 days/week	1 osprey	8/18/2009	NJ Audubon Society. 2009. Post-construction Wildlife Monitoring at the Atlantic City Utilities Authority - Jersey Atlantic Wind Power Facility. Submitted to New Jersey Board of Public Utilities.
Lempster, NH	forested ridgeline (12)	2009	April 15-Jun 1 and July 15 - Oct 31, 2009	4 daily	0	n/a	Tidhar, D., W. Tidhar, and M. Sonnenberg. 2010. Post-Construction Fatality Surveys for Lempster Wind Project. Prepared for Lempster Wind, LLC.
Lempster, NH	forested ridgeline (12)	2009	April 15-Jun 1 and July 15 - Oct 31, 2009	12 weekly	0	n/a	Tidhar, D., W. Tidhar, and M. Sonnenberg. 2010. Post-Construction Fatality Surveys for Lempster Wind Project. Prepared for Lempster Wind, LLC.
Stetson I, ME	forested ridgeline (38)	2009	2009	19 weekly	1 red-tailed hawk**	7/27/2009	Stantec Consulting. 2010. Stetson I Mountain Wind Project, Year 1 Post-Construction Monitoring Report, 2009. Prepared for First Wind Management, LLC.
Stetson II, ME	forested ridgeline (17)	2010	April 19 to Oct 15, 2010	17 weekly	0	n/a	Normandeau Associates. 2010. Stetson Mountain II Wind Project Year 1 Post-Construction Avian and Bat Mortality Monitoring. Prepared for First Wind, LLC.
Kibby, Maine	forested ridgeline (44)	2011	May 2 to June 20; July 11 to October 14, 2011	22 3 times every 2 wks	0	n/a	Stantec Consulting. 2011. 2011 Post-Construction Monitoring Report Kibby Wind Power Project, Franklin County, Maine. Prepared for TransCanada Hydro Northeast, Inc.
Rollins, Maine	forested ridgeline (40)	2012	April 15 to October 15, 2012	20 weekly	0	n/a	Stantec Consulting. 2012. RollinsWind Project Post-Construction Monitoring Report, 2012. Prepared for First Wind, LLC.
Stetson II, ME	forested ridgeline (17)	2012	April 15 to October 15, 2012	17 weekly	0	n/a	Stantec Consulting. 2012. Stetson II Wind Project Post-Construction Monitoring Report, 2012. Prepared for First Wind, LLC.
Record Hill, ME	forested ridgeline (22)	2012	April 15 to June 7 and July 7 to October 15, 2012	22 3 times every 2 wks	0	n/a	*this report*

*Results of spring interim report, study period April 20 to June 1.

**Fatality was result of electrocution at a riser pole of the electrical collection system

Appendix D Table 12 (continued)

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